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NOTICE OF ALLOWANCE AND FEE(S) DUE

84802 7590 04/17/2018
JONES DAY for Celgene Corporation
250 Vesey Street
NEW YORK, NEW YORK 10281-1047
UNITED STATES OF AMERICA

EXAMINER

ANDERSON, JAMES D

ART UNIT

PAPER NUMBER

1629

DATE MAILED: 04/17/2018

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/400,791	01/06/2017	Ho-Wah Hui	12827-966-999	4296

TITLE OF INVENTION: FORMULATIONS OF 2-(4-CHLOROPHENYL)-N-((2-(2,6-DIOXOPIPERIDIN-3-YL)-1-OXOISOINDOLIN-5-YL)METHYL)-2,2-DIFLUOROACETAMIDE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1000	\$0.00	\$0.00	\$1000	07/17/2018

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: **Mail** **Mail Stop ISSUE FEE**
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P.O. Box 1450
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INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

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JONES DAY for Celgene Corporation
250 Vesey Street
NEW YORK, NEW YORK 10281-1047
UNITED STATES OF AMERICA

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/400,791	01/06/2017	Ho-Wah Hui	12827-966-999	4296

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APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1000	\$0.00	\$0.00	\$1000	07/17/2018

EXAMINER	ART UNIT	CLASS-SUBCLASS
ANDERSON, JAMES D	1629	514-354000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

4b. Payment of Fee(s): (**Please first reapply any previously paid issue fee shown above**)

☐ Issue Fee

☐ A check is enclosed.

☐ Publication Fee (No small entity discount permitted)

☐ Payment by credit card. Form PTO-2038 is attached.

☐ Advance Order - # of Copies _____

☐ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____



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250 Vesey Street				
NEW YORK, NEW YORK 10281-1047			ART UNIT	
UNITED STATES OF AMERICA			PAPER NUMBER	
			1629	
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Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 15/400,791	Applicant(s) Hui et al.	
	Examiner JAMES D ANDERSON	Art Unit 1629	AIA Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to Amendments filed 01/10/2018.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are 1-50. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a) ☐ All b) ☐ Some *c) ☐ None of the:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. _____.

3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892) 2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____ 3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____ 4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____	5. ☒ Examiner's Amendment/Comment 6. ☐ Examiner's Statement of Reasons for Allowance 7. ☐ Other _____
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/James D. Anderson/
Primary Examiner, Art Unit 1629

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Claim Status

Applicants' response and amendments to the claims, filed 01/10/2018, have been received and entered.

Claims 47-50 are newly added.

Claims 1-50 are pending and allowed.

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in an interview with Megha Bhumralkar on April 6, 2018.

The application has been amended as follows:

48. (Amended) The method of claim 47, wherein the hematologic malignancy is acute myelogenous leukemia, acute lymphocytic leukemia, adult T-cell leukemia, chronic lymphocytic leukemia, hairy cell leukemia, myelodysplasia, myeloproliferative disorders, chronic myelogenous leukemia, myelodysplastic syndrome, human lymphotropic virus-type 1 leukemia, mastocytosis, ~~or B-cell acute lymphoblastic leukemia. In some embodiments, the lymphoma is, for example,~~ diffuse large B-cell lymphoma, B-cell immunoblastic lymphoma, small non-cleaved cell

lymphoma, human lymphotropic virus-type 1 leukemia/lymphoma, adult T-cell lymphoma, peripheral T cell lymphoma (PTCL), cutaneous T-cell lymphoma, mantle cell lymphoma, Hodgkin lymphoma, non-Hodgkin lymphoma, AIDS-related lymphoma, follicular lymphoma, small lymphocytic lymphoma, T-cell/histiocyte rich large B-cell lymphoma, transformed lymphoma, primary mediastinal large B-cell lymphoma, splenic marginal zone lymphoma, Richter's transformation, nodal marginal zone lymphoma, or ALK-positive large B-cell lymphoma.

Conclusion

Claims 1-50 are allowed.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JAMES D ANDERSON whose telephone number is (571)272-9038. The examiner can normally be reached on Monday-Friday, 8:30 am - 5:00 pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jeffrey Lundgren can be reached on 571-272-5541. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like

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assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/James D. Anderson/

Primary Examiner, Art Unit 1629

AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

1. (Original) A lyophilized formulation comprising: Compound 1 (2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide), or a stereoisomer or mixture of stereoisomers, pharmaceutically acceptable salt, tautomer, prodrug, solvate, hydrate, co-crystal, clathrate, or polymorph thereof, a buffer and a bulking agent.
2. (Currently amended) The lyophilized formulation of claim 1, wherein Compound 1 comprises a solid form of CC1=CC=C(C=C1)N(C2=CC=CC=C2C(=O)N(C3=CC=CC=C3C(=O)O)C4=CC=CC=C4)C5=CC=CC=C5C6=CC=CC=C6.
3. (Currently amended) The lyophilized formulation of claim 1, wherein Compound 1 comprises an amorphous form of CC1=CC=C(C=C1)N(C2=CC=CC=C2C(=O)N(C3=CC=CC=C3C(=O)O)C4=CC=CC=C4)C5=CC=CC=C5C6=CC=CC=C6.
4. (Original) The lyophilized formulation of claim 1, wherein Compound 1 is present in an amount from about 0.1 to about 2% based on the total weight of the lyophilized formulation.
5. (Original) The lyophilized formulation of claim 1, wherein Compound 1 is present from about 0.1 to about 1% based on the total weight of the lyophilized formulation.
6. (Original) The lyophilized formulation of claim 1, wherein Compound 1 is present in about 0.36% based on the total weight of the lyophilized formulation.
7. (Original) The lyophilized formulation of claim 1, wherein the buffer is a citrate buffer.
8. (Currently amended) The lyophilized formulation of claim 1, wherein citrate buffer is present in an amount from about 5% to about 25% based on total weight of the lyophilized formulation.
9. (Currently amended) The lyophilized formulation of claim 1, wherein citrate buffer comprises anhydrous citric acid and anhydrous sodium citrate.

10. (Original) The lyophilized formulation of claim 9, wherein anhydrous citric acid is present in an amount from about 2% to about 10% based on total weight of the lyophilized formulation.

11. (Original) The lyophilized formulation of claim 9, wherein anhydrous citric acid is present in an amount from about 5% to about 8% based on total weight of the lyophilized formulation.

12. (Original) The lyophilized formulation of claim 9, wherein anhydrous citric acid is present in an amount from about 6% to about 8% based on total weight of the lyophilized formulation.

13. (Original) The lyophilized formulation of claim 9, wherein anhydrous citric acid is present in an amount of about 6.41% based on total weight of the lyophilized formulation.

14. (Original) The lyophilized formulation of claim 9, wherein anhydrous sodium citrate is present in an amount from about 2% to about 15% based on total weight of the lyophilized formulation.

15. (Original) The lyophilized formulation of claim 9, wherein anhydrous sodium citrate is present in an amount from about 4% to about 10% based on total weight of the lyophilized formulation.

16. (Original) The lyophilized formulation of claim 14, wherein anhydrous sodium citrate is present in an amount of about 6.37% based on total weight of the lyophilized formulation.

17. (Original) The lyophilized formulation of claim 1, wherein the bulking agent is selected from mannitol, sulfobutylether- β -cyclodextrin, β -cyclodextrin, hydroxypropyl β -cyclodextrin and methylated β -cyclodextrin.

18. (Original) The lyophilized formulation of claim 1, wherein the bulking agent is hydroxypropyl β -cyclodextrin.

19. (Original) The lyophilized formulation of claim 1, wherein the bulking agent is present in an amount from about 70% to about 95% based on total weight of the lyophilized formulation.

20. (Original) The lyophilized formulation of claim 1, wherein the bulking agent is present in an amount from about 80% to about 90% based on total weight of the lyophilized formulation.

21. (Currently amended) The lyophilized formulation of claim ~~[[1]]~~ 18, wherein hydroxypropyl β -cyclodextrin is present in an amount from about 80% to about 90% based on total weight of the lyophilized formulation.

22. (Currently amended) The lyophilized formulation of claim ~~[[1]]~~ 18, wherein hydroxypropyl β -cyclodextrin is present in an amount of about 86.86% based on total weight of the lyophilized formulation.

23. (Currently amended) The lyophilized formulation of claim 1, wherein Compound 1 is present from about 0.1 to about 1%, and the lyophilized formulation comprises anhydrous citric acid ~~is present~~ in an amount from about 6% to about 8%, anhydrous sodium citrate ~~is present~~ in an amount from about 4% to about 10% and the bulking agent ~~is present~~ in an amount from about 70% to about 95% based on total weight of the lyophilized formulation.

24. (Currently amended) The lyophilized formulation of claim 1, wherein Compound 1 is present in about 0.36%, and the lyophilized formulation comprises anhydrous citric acid ~~is present~~ in about 6.41%, anhydrous sodium citrate ~~is present~~ in about 6.37% and hydroxypropyl β -cyclodextrin ~~is present~~ in about 86.86% based on total weight of the lyophilized formulation.

25. (Original) A reconstituted formulation obtainable from the lyophilized formulation of claim 1 comprising a diluent.

26. (Currently amended) The reconstituted ~~aqueous~~ formulation of claim 25, wherein the ~~diluents~~ diluent is water.

27. (Currently amended) The reconstituted ~~aqueous~~ formulation of claim 25, wherein Compound 1 is present in an amount of about 0.1 to 1 mg/mL.

28. (Original) The reconstituted aqueous formulation of claim 26, wherein Compound 1 is present in an amount of about 0.5 mg/mL.

29. (Currently amended) The reconstituted aqueous formulation of claim ~~[[25]]~~ 26, wherein the ~~aqueous solution~~ formulation has a pH in a range from about 4 to about 5.

30. (Currently amended) The reconstituted aqueous formulation of claim ~~[[25]]~~ 26, wherein the ~~aqueous solution~~ formulation has a pH of about 4.3.

31. (Original) A method of treating cancer comprising administering to a mammal having cancer the lyophilized formulation of claim 1.

32. (Original) The method of claim 31, wherein the cancer is leukemia.

33. (Original) The method of claim 32, wherein the leukemia is chronic lymphocytic leukemia, chronic myelocytic leukemia, acute lymphoblastic leukemia or acute myeloid leukemia.

34. (Original) The method of claim 32, wherein the leukemia is an acute myeloid leukemia.

35. (Original) The method of claim 34, wherein the leukemia is relapsed, refractory or resistant to conventional therapy.

36. (Currently amended) The method of claim 31, further comprising administering a therapeutically effective amount of ~~another~~ a second active agent or a support care therapy.

37. (Currently amended) The method of claim 36, wherein the second active agent is 1) a therapeutic antibody that specifically binds to a cancer antigen or a pharmacologically active mutant thereof, 2) a hematopoietic growth factor, 3) a cytokine, 4) an anti-cancer agent, 5) an antibiotic, 6) a cox-2 inhibitor, 7) an immunomodulatory agent, 8) an immunosuppressive agent, or 9) a corticosteroid ~~or a pharmacologically active mutant or derivative thereof.~~

38. (Currently amended) A method of treating cancer comprising administering to a mammal having cancer the ~~aqueous solution~~ formulation of claim 25.

39. (Currently amended) The method of claim 32, wherein the method comprises administering the ~~aqueous solution~~ formulation intravenously.

40. (Original) The method of claim 38, wherein the cancer is leukemia.

41. (Original) The method of claim 40, wherein the leukemia is chronic lymphocytic leukemia, chronic myelocytic leukemia, acute lymphoblastic leukemia or acute myeloid leukemia.

42. (Original) The method of claim 40, wherein the leukemia is an acute myeloid leukemia.

43. (Original) The method of claim 42, wherein the leukemia is relapsed, refractory or resistant to conventional therapy.

44. (Currently amended) The method of claim 38, further comprising administering a therapeutically effective amount of ~~another~~ a second active agent or a support care therapy.

45. (Currently amended) The method of claim 44, wherein the second active agent is 1) a therapeutic antibody that specifically binds to a cancer antigen or a pharmacologically active mutant thereof, 2) a hematopoietic growth factor, 3) a cytokine, 4) an anti-cancer agent, 5) an

antibiotic, 6) a cox-2 inhibitor, 7) an immunomodulatory agent, 8) an immunosuppressive agent, or 9) a corticosteroid ~~or a pharmacologically active mutant or derivative thereof.~~

46. (Currently amended) A process for preparing a lyophilized formulation, comprising: dissolving a bulking agent and [[C]]2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide[[C]], or a stereoisomer or mixture of stereoisomers, pharmaceutically acceptable salt, tautomer, prodrug, solvate, hydrate, co-crystal, clathrate, or polymorph thereof in a buffer solution to produce a solution; and lyophilizing the resulting solution to produce a powder.

47. (New) The method of claim 31, wherein the cancer is a hematologic malignancy.

48. (New) The method of claim 47, wherein the hematologic malignancy is acute myelogenous leukemia, acute lymphocytic leukemia, adult T-cell leukemia, chronic lymphocytic leukemia, hairy cell leukemia, myelodysplasia, myeloproliferative disorders, chronic myelogenous leukemia, myelodysplastic syndrome, human lymphotropic virus-type 1 leukemia, mastocytosis, or B-cell acute lymphoblastic leukemia. In some embodiments, the lymphoma is, for example, diffuse large B-cell lymphoma, B-cell immunoblastic lymphoma, small non-cleaved cell lymphoma, human lymphotropic virus-type 1 leukemia/lymphoma, adult T-cell lymphoma, peripheral T cell lymphoma (PTCL), cutaneous T-cell lymphoma, mantle cell lymphoma, Hodgkin lymphoma, non-Hodgkin lymphoma, AIDS-related lymphoma, follicular lymphoma, small lymphocytic lymphoma, T-cell/histiocyte rich large B-cell lymphoma, transformed lymphoma, primary mediastinal large B-cell lymphoma, splenic marginal zone lymphoma, Richter's transformation, nodal marginal zone lymphoma, or ALK-positive large B-cell lymphoma.

49. (New) The method of claim 31, wherein the cancer is a solid tumor.

50. (New) The method of claim 31, wherein the cancer is a cancer of bladder, bone, blood, brain, breast, cervix, chest, colon, endometrium, esophagus, eye, head, kidney, liver, lymph nodes, lung, mouth, neck, ovaries, pancreas, prostate, rectum, stomach, testis, throat, or uterus.

REMARKS

Claims 1-46 are pending. New claims 47-50 are added. Support for claims 47 and 48 is found in the application at paragraph [0080]. Support for claims 49 and 50 is found in the application at paragraph [00177]. Claims 1-50 will be pending following entry of this amendment.

Claims 2, 3, 8, 9, 21-24, 26-27, 29-30, 36-39 and 44-46 are amended without prejudice or disclaimer. The claims are amended for clarity. No new matter is added.

I. Claim Objections

The PTO objects to claims 2, 3 and 46 for reciting the compound name in parenthesis. Claims 2, 3 and 46 are amended herein, without prejudice, to delete the parenthesis.

Claim 26 is objected for recitation of the plural term “diluent”. Claim 26 is amended to replace the term “diluent” with the term “diluent”.

II. Rejection of Claims under 35 U.S.C. § 112(b)

Claims 8-16 are rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite.

The PTO alleges that claim 1, from which claims 8 and 9 depend, provides insufficient antecedent basis for recitation of citrate buffer in claims 8 and 9. Claims 8 and 9 are amended to depend from claim 7 which provides proper antecedent basis for recitation of citrate buffer in claims 8 and 9.

Claims 21 and 22 are rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite.

The PTO alleges that claim 1, from which claims 21 and 22 depend, provides insufficient antecedent basis for recitation of hydroxypropyl β -cyclodextrin in claims 21 and 22. Claims 21 and 22 are amended to depend from claim 18 which provides proper antecedent basis for recitation of hydroxypropyl β -cyclodextrin in claims 21 and 22.

Claims 23 and 24 are rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite.

The PTO alleges that claim 1, from which claims 23 and 24 depend, provides insufficient antecedent basis for recitation of anhydrous citric acid, anhydrous sodium citrate and hydroxypropyl β -cyclodextrin in claims 23 and 24. Claims 23 and 24 are amended herein to properly depend from claim 1.

Claims 29-30 and 38-45 are rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite.

The PTO alleges that claim 25, from which claims 29-30 depend, provides insufficient antecedent basis for recitation of the phrase “aqueous solution” in claims 29-30. Claims 29 and 30 are amended to change their dependencies to depend from claim 26, and to replace the phrase “aqueous solution” with the term “formulation” which finds proper antecedent basis in base claim 26.

The PTO alleges that claim 25, from which claim 38 depends, provides insufficient antecedent basis for recitation of the phrase “aqueous solution” in claim 38. Claim 38 is amended to change its dependency to depend from claim 26, and to replace the phrase “aqueous solution” with the term “formulation” which finds proper antecedent basis in base claim 26.

The PTO alleges that claim 32, from which claim 39 depends, provides insufficient antecedent basis for recitation of the phrase “aqueous solution” in claim 39. Claim 39 is amended to change its dependency to depend from claim 26, and to replace the phrase “aqueous solution” with the term “formulation” which finds proper antecedent basis in base claim 26.

The rejection of claims 40-45 that depend directly or indirectly from claim 38 is moot in view of the amendment to claim 38.

Claims 36 and 44 are rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite.

Claims 36 and 44 are allegedly indefinite for use of the phrase “another second active agent”. The PTO indicates that either the term “another” or the term “second” is superfluous. Without acquiescing to the propriety of the rejection, and solely to promote prosecution of this application, the term “another” is deleted from claims 36 and 44.

Claims 37 and 45 are rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite.

Claims 37 and 45 are allegedly indefinite for recitation of unclear Markush group. The PTO further alleges that it is unclear what “...or a pharmacologically active mutant or derivative thereof” is referring to. The PTO further alleges that the term “derivative” is relative and renders the claim indefinite.

Claims 37 and 45 are amended herein to clearly recite the claimed Markush groups. Claims 37 and 45 are further amended herein to clarify that the phrase “...or a pharmacologically active mutant” refers to the therapeutic antibody recited in the claims. Furthermore, without

acquiescing to the propriety of the rejection, and solely to promote prosecution of this application, the term “derivative” has been deleted from the claims without prejudice or disclaimer.

CONCLUSION

Applicants believe no fees are due in connection with this Response. However, if there are any fees due, please charge them to Deposit Account 50-3013 (CAM 226269-999966).

Respectfully submitted,

Date: January 10, 2018

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JONES DAY for Celgene Corporation			EXAMINER	
250 Vesey Street			ANDERSON, JAMES D	
NEW YORK, NY 10281-1047				
			ART UNIT	PAPER NUMBER
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

DETAILED CORRESPONDENCE

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Formal Matters

Claims 1-46 are pending and under examination.

Priority

This application claims the benefit of the priority of U.S. Provisional Application No. 62/276,756, filed January 8, 2016.

Information Disclosure Statement

Receipt is acknowledged of the Information Disclosure Statement filed 03/28/2017. The Examiner has considered the references cited therein to the extent that each is a proper citation. Please see the attached USPTO Form 1449.

Claim Objections

Claims 2-3 and 46 are objected to because of the following informalities: The claims recite “(2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide)”. The beginning and ending parentheses are unnecessary in the recitation of this compound name. Appropriate correction is required.

Claim 26 is objected to because of the following informalities: In line 1, the claim recite “the diluents is water”, which should read “the diluent is water”. Appropriate correction is required.

Claim Rejections - 35 USC § 112 – 2nd Paragraph

The following is a quotation of 35 U.S.C. 112(b):

(B) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

"The primary purpose of this requirement of definiteness of claim language is to ensure that the scope of the claims is clear so the public is informed of the boundaries of what constitutes infringement of the patent. A secondary purpose is to provide a clear measure of what applicants regard as the invention so that it can be determined whether the claimed invention meets all the criteria for patentability and whether the specification meets the criteria of 35 U.S.C. 112, first paragraph with respect to the claimed invention.", (see MPEP § 2173).

Claims 8-16 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 8 and 9 depend from Claim 1 and recite the limitation “wherein citrate buffer is present...”. There is insufficient antecedent basis for this limitation in the claims because Claim

1, from which claims 8 and 9 depend, does not recite citrate buffer. It appears these claims may have been intended to depend from Claim 7, which does recite that the buffer (recited in Claim 1) is citrate buffer.

Claims 21-22 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 21 and 22 depend from Claim 1 and recite the limitation “wherein hydroxypropyl β -cyclodextrin is present...”. There is insufficient antecedent basis for this limitation in the claims because Claim 1, from which claims 21 and 22 depend, does not recite hydroxypropyl β -cyclodextrin. It appears these claims may have been intended to depend from Claim 18, which does recite that the bulking agent (recited in Claim 1) is hydroxypropyl β -cyclodextrin.

Claims 23-24 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 23 and 24 depend from Claim 1 and recite the limitations “...wherein...anhydrous citric acid is present...anhydrous sodium citrate is present...and “...hydroxypropyl β -cyclodextrin is present...”. There is insufficient antecedent basis for these limitations in the claims because Claim 1, from which claims 23 and 24 depend, does not recite anhydrous citric acid, anhydrous sodium citrate, or hydroxypropyl β -cyclodextrin.

Claims 29-30 and 38-45 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 29-30 depend from Claim 25 and recite the limitation "...wherein the aqueous solution...". There is insufficient antecedent basis for these limitations in the claims because Claim 25, from which claims 29 and 30 depend, does not recite as aqueous solution.

Claim 38 recites a method comprising administering "the aqueous solution of claim 25". There is insufficient antecedent basis for this limitation in the claims because Claim 25 does not recite as aqueous solution.

Claim 39 recites the method of Claim 32 comprising administering "the aqueous solution intravenously". There is insufficient antecedent basis for this limitation in the claims because Claim 32 does not recite as aqueous solution.

Claims 40-45 depend directly or indirectly from rejected Claim 38 and are therefore also indefinite.

Claims 36 and 44 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 36 and 44 depend from Claims 31 and 44 respectively and recite the phrase "another second active agent". There is insufficient antecedent basis for this limitation in the claims because Claims 31 and 44 from which the rejected claims depend, do not recite a (first) second active agent, so it is unclear how there could not be "another" second active agent. It appears that either the word "another" or "second" is superfluous in the rejected claims.

Claims 37 and 45 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 37 and 45 recite:

37. The method of claim 36, wherein the second active agent is a therapeutic antibody that specifically binds to a cancer antigen, hematopoietic growth factor, cytokine, anti-cancer agent, antibiotic, cox-2 inhibitor, immunomodulatory agent, immunosuppressive agent, corticosteroid or a pharmacologically active mutant or derivative thereof.

45. The method of claim 44, wherein the second active agent is a therapeutic antibody that specifically binds to a cancer antigen, hematopoietic growth factor, cytokine, anti-cancer agent, antibiotic, cox-2 inhibitor, immunomodulatory agent, immunosuppressive agent, corticosteroid or a pharmacologically active mutant or derivative thereof.

Firstly, it is unclear if Applicants are claiming a Markush Group of second active agents, i.e., each of 1) a therapeutic antibody that specifically binds to a cancer antigen, 2) hematopoietic growth factor, 3) cytokine, 4) anti-cancer agent, 5) antibiotic, 6) cox-2 inhibitor, 7) immunomodulatory agent, 8) immunosuppressive agent, and 9) corticosteroid or a pharmacologically active mutant or derivative thereof are possible selections of the second active agent. Or, is it Applicants' intent that the second active agent is a therapeutic antibody *that specifically binds to a* 1) cancer antigen, 2) hematopoietic growth factor, 3) cytokine, 4) anti-cancer agent, 5) antibiotic, 6) cox-2 inhibitor, 7) immunomodulatory agent, 8) immunosuppressive agent, or 9) corticosteroid or a pharmacologically active mutant or derivative thereof.

Secondly, it is unclear what "...or a pharmacologically active mutant or derivative thereof" is referring to. For example, this could be interpreted to only apply to the corticosteroid or this could be interpreted to apply to all of the previously recited agents. This ties back to the issue above because if it is Applicants' intent that the second active agent is a therapeutic antibody *that*

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specifically binds to a 1) cancer antigen, 2) hematopoietic growth factor, 3) cytokine, 4) anti-cancer agent, 5) antibiotic, 6) cox-2 inhibitor, 7) immunomodulatory agent, 8) immunosuppressive agent, or 9) corticosteroid, then "...or a pharmacologically active mutant or derivative thereof" could also be interpreted to only apply to the therapeutic antibody.

Thirdly, regardless of what "...or a pharmacologically active mutant or derivative thereof" refers to, the term "derivative" is a relative term which renders the claim indefinite. In particular, "derivative" does not particularly point out the degree or type of derivation that a given antibody, enzyme, or compound may have in relation to the parent antibody, enzyme, or compound and still be considered a "derivative" as intended by Applicants. Applicants have failed to provide any specific definition for this term in the present specification. The Examiner acknowledges Applicants' discussion at [0225] of the published Application where examples of derivatives include, but are not limited to, pegylated derivatives and fusion proteins, such as proteins formed by fusing IgG1 or IgG3 to the protein or active portion of the protein of interest. However, such description only provides non-limiting examples of such derivatives. Lacking a limiting definition, the skilled artisan would not be reasonably apprised of the metes and bounds of the subject matter for which Applicants seek patent protection. Rather, a subjective interpretation of the claimed language would be required. However, as such is deemed inconsistent with the tenor and express language of 35 U.S.C. § 112, second paragraph, the claims are deemed properly rejected.

Allowable Subject Matter

Claims 1, 4-7, 17-20, 25, 27-28, and 31-35 are allowed.

The following is a statement of reasons for the indication of allowable subject matter: The prior art does not teach or reasonably suggest the compound 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide as recited in the instant claims. As such, lyophilized formulations comprising the claimed compound as recited in the instant claims are novel and unobvious.

The closest art disclosing the claimed compound is US 2016/0009683 A1 (Published Jan. 14, 2016; Filed Jul. 11, 2014). This reference is not available as prior art under 35 U.S.C. 102(a)(1) because it was published after Applicants' earliest filing date (Jan. 8, 2016). This reference cannot be applied under 35 U.S.C. 102(a)(2) because it is a commonly owned disclosure and therefore qualifies as an exception under 35 U.S.C. 102(b)(2).

Conclusion

Claims 1, 4-7, 17-20, 25, 27-28, and 31-35 are allowed.

Claims 8-16, 21-24, 29-30, and 36-45 are rejected.

Claims 2-3 and 46 are objected to.

If applicants should amend the claims, a complete and responsive reply will clearly identify where support can be found in the disclosure for each amendment. Applicants should point to the page and line numbers of the application corresponding to each amendment, and provide any statements that might help to identify support for the claimed invention (e.g., if the amendment is not supported in *ipsis verbis*, clarification on the record may be helpful). Should applicants present new claims, applicants should clearly identify where support can be found in the disclosure

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to JAMES D ANDERSON whose telephone number is (571)272-9038. The examiner can normally be reached on Monday-Friday, 8:30 am - 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jeffrey Lundgren can be reached on 571-272-5541. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/James D. Anderson/

James D. Anderson, Ph.D.

Primary Patent Examiner, Art Unit 1629

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Señor

DIRECTOR DIVISIÓN DE NUEVAS CREACIONES

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

E.

S.

D.

REF: Expediente No. **NC2018/0008305**

PETICION TRAMITE ACELERADO DE PATENTES

JUAN PABLO CADENA SARMIENTO, portador de la tarjeta profesional No. 57.492 del C.S.J., obrando como apoderado de la sociedad solicitante me permito presentar los siguientes documentos para participar en el programa de trámite acelerado de patentes.

- a. Copia de la acción oficial de patentabilidad emitida por la USPTO de fecha **octubre 12 de 2017** junto con la respectiva traducción al castellano.
- b. Copia de la respuesta del solicitante a la acción oficial radicada el **10 de enero de 2018** junto con las reivindicaciones modificadas **1-50** y su respectiva traducción al castellano.
- c. Copia de la notificación de concesión (Notice of allowability) en donde se establece que las reivindicaciones concedidas son las **1-50** de la respuesta radicada el **10 de enero de 2018**.
- d. Notificación de aceptación (notice of allowance) en donde se establece que la solicitud ha sido examinada y aceptada para conceder la patente.
- e. Copia de la patente **US 10,052,315** con las reivindicaciones concedidas **1-50**.
- f. Tabla de correspondencia en donde se observa que las reivindicaciones concedidas por la USPTO son las mismas modificadas en Colombia el **4 de abril de 2019**.

Del Señor Director,

JUAN PABLO CADENA SARMIENTO

T.P. No. 57.492 del C.S.J.

C.C. 80.410.337 de Usaquén

Calle 70 A No. 4 - 41

EN LA OFICINA DE PATENTES Y MARCAS DE ESTADOS UNIDOS

MODIFICACIONES Y RESPUESTA

En respuesta a la Acción Oficial No-Final enviada vía correo electrónico el 12 de Octubre de 2017, agradecemos considerar los siguientes modificaciones y observaciones.

Las **Modificaciones a las Reivindicaciones** se reflejan en la lista de reivindicaciones que comienza en la página 2 de este documento.

Las **Observaciones** comienzan en la página 7 de este documento.

MODIFICACIONES A LAS REIVINDICACIONES

La siguiente lista de reivindicaciones reemplazará todas las versiones anteriores y listas, de reivindicaciones en la solicitud:

1. (Original) Una formulación liofilizada que comprende: El Compuesto 1 (2-(4-clorofenil)-N-((2-(2,6-dioxopiperidin-3-il)-1-oxoisindolin-5-il)metil)-2,2-difluoroacetamida) o un estereoisómero o mezcla de estereoisómeros, una sal farmacéuticamente aceptable, tautómero, profármaco, solvato, hidrato, cocrystal, clatrato o polimorfo de estos, un amortiguador y un agente espesante.
2. (Actualmente modificada) La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 comprende una forma sólida de {2-(4-clorofenil)-N-((2-(2,6-dioxopiperidin-3-il)-1-oxoisindolin-5-il)metil)-2,2-difluoroacetamida}.
3. (Actualmente modificada) La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 comprende una forma amorfa de {2-(4-clorofenil)-N-((2-(2,6-dioxopiperidin-3-il)-1-oxoisindolin-5-il)metil)-2,2-difluoroacetamida}.
4. (Original) La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 se encuentra presente en una cantidad de alrededor de 0.1 a alrededor de 2 % según el peso total de la formulación liofilizada.
5. (Original) La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 se encuentra presente de alrededor de 0.1 a alrededor de 1% según el peso total de la formulación liofilizada.
6. (Original) La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 se encuentra presente en alrededor de 0.36 % según el peso total de la formulación liofilizada.
7. (Original) La formulación liofilizada de la reivindicación 1, en donde el amortiguador es un amortiguador de citrato.
8. (Actualmente modificada) La formulación liofilizada de la reivindicación $\pm$ 7, en donde el amortiguador de citrato se encuentra presente en una cantidad de alrededor de 5 % a alrededor de 25 % según el peso total de la formulación liofilizada.
9. (Actualmente modificada) La formulación liofilizada de la reivindicación $\pm$ 7, en donde el amortiguador de citrato comprende ácido cítrico anhidro y citrato de sodio anhidro.
10. (Original) La formulación liofilizada de la reivindicación 9, en donde el ácido cítrico anhidro se encuentra presente en una cantidad de alrededor de 2% a alrededor de 10% según el peso total de la formulación liofilizada.
11. (Original) La formulación liofilizada de la reivindicación 9, en donde el ácido

cítrico anhidro se encuentra presente en una cantidad de alrededor de 5 % a alrededor de 8 % según el peso total de la formulación liofilizada.

12. (Original) La formulación liofilizada de la reivindicación 9, en donde el ácido cítrico anhidro se encuentra presente en una cantidad de alrededor de 6 % a alrededor de 8 % según el peso total de la formulación liofilizada.

13. (Original) La formulación liofilizada de la reivindicación 9, en donde el ácido cítrico anhidro se encuentra presente en una cantidad de alrededor de 6.41 % según el peso total de la formulación liofilizada.

14. (Original) La formulación liofilizada de la reivindicación 9, en donde el citrato de sodio anhidro se encuentra presente en una cantidad de alrededor de 2 % a alrededor de 15 % según el peso total de la formulación liofilizada.

15. (Original) La formulación liofilizada de la reivindicación 9, en donde el citrato de sodio anhidro se encuentra presente en una cantidad de alrededor de 4 % a alrededor de 10 % según el peso total de la formulación liofilizada.

16. (Original) La formulación liofilizada de la reivindicación 14, en donde el citrato de sodio anhidro se encuentra presente en una cantidad de alrededor de 6.37 % según el peso total de la formulación liofilizada.

17. (Original) La formulación liofilizada de la reivindicación 1, en donde el agente espesante se selecciona de manitol, sulfobutiléter- β -ciclodextrina, β -ciclodextrina, hidroxipropil β -ciclodextrina y β -ciclodextrina metilada.

18. (Original) La formulación liofilizada de la reivindicación 1, en donde el agente espesante es hidroxipropil β -ciclodextrina.

19. (Original) La formulación liofilizada de la reivindicación 1, en donde el agente espesante se encuentra presente en una cantidad de alrededor de 70 % a alrededor de 95 % según el peso total de la formulación liofilizada.

20. (Original) La formulación liofilizada de la reivindicación 1, en donde el agente espesante se encuentra presente en una cantidad de alrededor de 80% a alrededor de 90% según el peso total de la formulación liofilizada.

21. (Actualmente modificada) La formulación liofilizada de la reivindicación $\pm$ 18, en donde hidroxipropil β -ciclodextrina se encuentra presente en una cantidad de alrededor de 80 % a alrededor de 90 % según el peso total de la formulación liofilizada.

22. (Actualmente modificada) La formulación liofilizada de la reivindicación $\pm$ 18, en donde hidroxipropil β -ciclodextrina se encuentra presente en una cantidad de alrededor de 86.86 % según el peso total de la formulación liofilizada.

23. (Actualmente modificada) La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 se encuentra presente de alrededor de 0.1 a alrededor de 1 %, y la formulación liofilizada comprende el ácido cítrico anhidro ~~se encuentra presente~~ en una cantidad de alrededor de 6 % a alrededor de 8 %, el citrato de sodio anhidro ~~se encuentra presente~~ en una cantidad de alrededor de 4 % a alrededor de 10 % y el agente espesante ~~se encuentra presente~~ en una cantidad de alrededor de 70 % a alrededor de 95 % según el peso total de la formulación liofilizada.

24. (Actualmente modificada) La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 se encuentra presente en alrededor de 0.36 %, y la formulación liofilizada comprende ácido cítrico anhidro ~~se encuentra presente~~ en alrededor de 6.41 %, citrato de sodio anhidro ~~se encuentra presente~~ en alrededor de 6.37 % y la hidroxipropil β -ciclodextrina ~~se encuentra presente~~ en alrededor de 86.86 % según el peso total de la formulación liofilizada.

25. (Original) Una formulación reconstituida que se puede obtener a partir de la formulación liofilizada de la reivindicación 1 que comprende un diluyente.

26. (Actualmente modificada) La formulación ~~acuosa~~ reconstituida de la reivindicación 25, en donde el ~~diluyentes~~ diluyente es agua.

27. (Actualmente modificada) La formulación ~~acuosa~~ reconstituida de la reivindicación 25, en donde el Compuesto 1 se encuentra presente en una cantidad de alrededor de 0.1 a 1 mg/mL.

28. (Original) La formulación acuosa reconstituida de la reivindicación 26, en donde el Compuesto 1 se encuentra presente en una cantidad de alrededor de 0.5 mg/mL.

29. (Actualmente modificada) La formulación acuosa reconstituida de la reivindicación ~~25~~ 26, en donde la ~~solución acuosa~~ formulación tiene un pH en un intervalo de alrededor de 4 a alrededor de 5.

30. (Actualmente modificada) La formulación acuosa reconstituida de la reivindicación ~~25~~ 26, en donde la ~~solución acuosa~~ formulación tiene un pH de alrededor de 4.3.

31. (Original) Un método para tratar el cáncer que comprende la administración a un mamífero que tiene cáncer la formulación liofilizada de la reivindicación 1.

32. (Original) El método de la reivindicación 31, en donde el cáncer es leucemia.

33. (Original) El método de la reivindicación 32, en donde la leucemia es leucemia linfocítica crónica, leucemia mielocítica crónica, leucemia linfoblástica aguda o leucemia mieloide aguda.

34. (Original) El método de la reivindicación 32, en donde la leucemia es una leucemia mieloide aguda.

35. (Original) El método de la reivindicación 34, en donde la leucemia es recidivante, refractaria o resistente a la terapia convencional.

36. (Actualmente modificada) El método de la reivindicación 31, que comprende además la administración de una cantidad terapéuticamente eficaz de ~~entre~~ un agente activo secundario o una terapia de cuidados complementarios.

37. (Actualmente modificada) El método de la reivindicación 36, en donde el agente activo secundario es 1) un anticuerpo terapéutico que se une específicamente a un antígeno de cáncer o una mutación farmacológicamente activa del mismo, 2) un factor de crecimiento hematopoyético, 3) una citocina, 4) un agente contra el cáncer, 5) un antibiótico, 6) un inhibidor cox-2, 7) un agente inmunomodulador, 8) un agente inmunosupresor, o 9) un corticosteroide o una mutación farmacológicamente activa o derivado de esta.

38. (Actualmente modificada) Un método para tratar el cáncer que comprende la administración a un mamífero que tiene cáncer la formulación ~~solución acuosa~~ de la reivindicación 25.

39. (Actualmente modificada) El método de la reivindicación 32, en donde el método comprende la administración intravenosa de la formulación ~~solución acuosa~~.

40. (Original) El método de la reivindicación 38, en donde el cáncer es leucemia.

41. (Original) El método de la reivindicación 40, en donde la leucemia es leucemia linfocítica crónica, leucemia mielocítica crónica, leucemia linfoblástica aguda o leucemia mieloide aguda.

42. (Original) El método de la reivindicación 40, en donde la leucemia es una leucemia mieloide aguda.

43. (Original) El método de la reivindicación 42, en donde la leucemia es recidivante, refractaria o resistente a la terapia convencional.

44. (Actualmente modificada) El método de la reivindicación 38, que comprende además la administración de una cantidad terapéuticamente eficaz de ~~entre~~ un agente activo secundario o una terapia de cuidados complementarios.

45. (Actualmente modificada) El método de la reivindicación 44 en donde el agente activo secundario es 1) un anticuerpo terapéutico que se une específicamente a un antígeno de cáncer o una mutación farmacológicamente activa del mismo, 2) un factor de crecimiento hematopoyético, 3) una citocina, 4) un agente contra el cáncer, 5) un antibiótico,

6) un inhibidor cox-2, 7) un agente inmunomodulador, 8) un agente inmunosupresor, o 9) un corticosteroide o una mutación farmacológicamente activa o derivado de esta.

46. (Actualmente modificada) Un proceso para preparar una formulación liofilizada, que comprende: disolver un agente espesante y {2-(4-clorofenil)-N-((2-(2,6-dioxopiperidin-3-il)-1-oxoisindolin-5-il)metil)-2,2-difluoroacetamida}, o un estereoisómero o mezcla de estereoisómeros, sal farmacéuticamente aceptable, tautómero, profármaco, solvato, hidrato, co-cristal, clatrato o polimorfo de estos en una solución amortiguadora para producir una solución; y liofilizar la solución resultante para producir un polvo.

47. (Nueva) El método de la reivindicación 31, en donde el cáncer es una malignidad hematológica.

48. (Nueva) El método de la reivindicación 47, en donde la malignidad hematológica es leucemia mielógena aguda, leucemia linfocítica aguda, leucemia de linfocitos T en adultos, leucemia linfocítica crónica, leucemia de células pilosas, mielodisplasia, trastorno mieloproliferativo, leucemia mielógena crónica, síndrome mielodisplásico, leucemia tipo 1 del virus linfotrópico humana, mastocitosis o leucemia linfoblástica aguda de células B. En algunas modalidades, el linfoma es, por ejemplo, linfoma difuso de células B grandes, linfoma inmunoblástico de linfocitos B, linfoma de células pequeñas no hendidas, leucemia/linfoma tipo 1 del virus linfotrópico humano, linfoma de linfocitos T en adultos, linfoma de células T periféricos (PTCL), linfoma cutáneo de células T, linfoma de células del manto, linfoma de Hodgkin, linfoma no Hodgkin, linfoma relacionado concélulas-T/histiocitos, linfoma transformado, linfoma de células B grandes mediastinal primario, linfoma de la zona marginal esplénica, transformación de Richter, linfoma de la zona marginal nodal o linfoma de células B grandes positivo para ALK.

49. (Nueva) El método de la reivindicación 31, en donde el cáncer es un tumor sólido.

50. (Nueva) El método de la reivindicación 31, en donde el cáncer es un cáncer de ánceres de la vejiga, de hueso, de sangre, cerebro, mama, cuello de útero, pecho, colon, endometrio, esófago, ojo, cabeza, riñón, hígado, ganglios linfáticos, pulmón, boca, cuello, ovarios, páncreas, próstata, recto, estómago, testículos, garganta y útero.

OBSERVACIONES

Las Reivindicaciones 1-46 son las actualmente presentadas. Las Nuevas reivindicaciones 47-50 son agregadas. Soporte para las reivindicaciones 47 y 48 se encuentra en la solicitud en el párrafo [0080]. Soporte para las reivindicaciones 49 y 50 se encuentra en la solicitud en el párrafo [00177]. Reivindicaciones 1-50 serán las actualmente presentadas tras la entrada de esta modificación.

Las Reivindicaciones 2, 3, 8, 9, 21-24, 26-27, 29-30, 36-39 y 44-46 son modificadas sin perjuicio o renuncia. Las Reivindicaciones son modificadas para mayor claridad. No se adiciona materia nueva.

I. Objeciones a las Reivindicaciones

La Oficina de Patentes objeta las reivindicaciones 2, 3 y 46 para recitar el nombre del compuesto en paréntesis.

Las Reivindicaciones 2, 3 y 46 son modificadas, sin perjuicio, para eliminar los paréntesis.

La Reivindicación 26 es objetada por recitar el término plural “diluyentes”. La Reivindicaciones 26 es modificada para reemplazar el término “diluyentes” por el término “diluyente”.

II. Rechazo de las Reivindicaciones bajo 35 U.S.C. § 112(b)

Las Reivindicaciones 8-16 son objetadas bajo 35 U.S.C. § 112, segundo párrafo, como indefinidas.

La Oficina de Patentes alega que la reivindicación 1, de la cual las reivindicaciones 8 y 9 son dependientes, proporciona una base de antecedente insuficiente para recitar el amortiguador de citrato en las reivindicaciones 8 y 9.

Las Reivindicaciones 21 y 22 son rechazadas bajo 35 U.S.C. § 112, segundo párrafo, como indefinidas.

La Oficina de Patentes alega que la reivindicación 1, de la cual las reivindicaciones 21 y 22 son dependientes, proporciona una base de antecedente insuficiente para recitar el hidroxipropil β -ciclodextrina en las reivindicaciones 21 y 22.

Las Reivindicaciones 21 y 22 son modificadas para depender de la reivindicación 18, la cual proporciona una base de antecedente adecuada para recitar el hidroxipropil β -ciclodextrina en las reivindicaciones 21 y 22.

Las Reivindicaciones 23 y 24 son rechazadas bajo 35 U.S.C. § 112, segundo párrafo, como indefinidas.

La Oficina de Patentes alega que la reivindicación 1, de la cual las reivindicaciones 23 y 24 son dependientes, proporciona una base de antecedente insuficiente para recitar el ácido cítrico anhidro, citrato de sodio anhidro e hidroxipropil β -ciclodextrina en las

reivindicaciones 23 y 24. Las Reivindicaciones 23 y 24 son modificadas para que dependan apropiadamente de la reivindicación 1.

Las Reivindicaciones 29-30 y 38-45 son rechazadas bajo 35 U.S.C. § 112, segundo párrafo, como indefinidas.

La Oficina de Patentes alega que la reivindicación 25, de la cual las reivindicaciones 29-30 dependen, proporcionan base de antecedente insuficiente por recitar la frase “solución acuosa” en las reivindicaciones 29-30. Las Reivindicaciones 29 y 30 son modificadas para cambiar sus dependencias y depender de la reivindicación 26, y reemplazar la frase “solución acuosa” con el término “formulación”, la cual encuentra base de antecedente adecuada en la reivindicación 26.

La Oficina de Patentes alega que la reivindicación 25, de la cual depende la reivindicación 38, proporciona base de antecedente insuficiente para recitar la frase “solución acuosa” en la reivindicación 38. La Reivindicación 38 es modificada para cambiar su dependencia para depender de la reivindicación 26, y para reemplazar la frase “solución acuosa” con el término “formulación”, el cual encuentra base de antecedente apropiada en la reivindicación 26.

La Oficina de Patentes alega que la reivindicación 32, de la cual depende la reivindicación 39, proporciona base de antecedente insuficiente para recitar la frase “solución acuosa” en la reivindicación 39. La Reivindicación 39 es modificada para cambiar su dependencia para depender de la reivindicación 26, y para reemplazar la frase “solución acuosa” por el término “formulación” el cual encuentra base de antecedente en la reivindicación 26.

El rechazo de las reivindicaciones 40-45 que dependen directamente o indirectamente de la reivindicación 38 es superado en vista de las modificaciones a la reivindicación 38.

Las Reivindicaciones 36 y 44 son rechazadas bajo 35 U.S.C. § 112, segundo párrafo, como indefinidas.

Las Reivindicaciones 36 y 44 son objetadas por ser indefinidas debido al uso de la frase “otro agente activo secundario”. La Oficina de Patentes indica que el término “otro” o el término “secundario” son superfluos.

Sin asentir a la propiedad del rechazo, y únicamente para promover el trámite de la presente solicitud, el término “otro” es eliminado de las reivindicaciones 36 y 44.

Las Reivindicaciones 37 y 45 son rechazadas bajo 35 U.S.C. § 112, segundo párrafo, como indefinidas.

Las Reivindicaciones 37 y 45 son indefinidas para recitar un grupo poco claro de Markush. La Oficina de Patentes además alega que no es claro a que se refiere “... o una mutación farmacológicamente activa o un derivado de esta”.

Las Reivindicaciones 37 y 45 son modificadas para recitar claramente los grupos de Markush reclamados.

Las Reivindicaciones 37 y 45 son adicionalmente modificadas para clarificar que la frase “... o una mutación farmacológicamente activa” se refiere al anticuerpo terapéutico recitado en las reivindicaciones. Adicionalmente, sin asentir a la propiedad del rechazo, y únicamente para promover el trámite de la presente solicitud, el término “derivado” es eliminado de las reivindicaciones sin perjuicio o renuncia.

CONCLUSIÓN

Los Solicitantes creen que no hay tarifas en conexión con esta respuesta. Sin embargo, si existe alguna tarifa, por favor carguen la misma a la Cuenta de Depósito 50-3013 (CAM 226269-999966).

Respetuosamente presentado,

Fecha: Enero 10, 2018

/Megha Bhumralkar/

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Por favor encuentre abajo y/o adjunto una comunicación de Oficina relacionada con esta solicitud o procedimiento.

El período de tiempo para responder, si algo, está establecido en la comunicación adjunta.

ACCIÓN DETALLADA

Nota del Estado de Pre-AIA o AIA

La presente solicitud, presentada en o después de Marzo 16 de 2013, es examinada bajo el primer inventor para presentar disposiciones de la AIA.

Asuntos Formales

Las Reivindicaciones 1-46 son las actualmente presentadas y las examinadas.

Objeciones a las Reivindicaciones

Las Reivindicaciones 2-3 y 46 son objetadas debido a las siguientes informalidades: Las reivindicaciones recitan “(2-(4-clorofenil)-N-((2-(2,6-dioxopiperidin-3-il)-1-oxoisindolin-5-il)metil)-2,2-difluoroacetamida)”. El comienzo y el final de los paréntesis son innecesarios en la mención del nombre de este compuesto. Se requiere una corrección apropiada.

La Reivindicación 26 es objetada debido a las siguientes informalidades: En la línea 1, esta reivindicación menciona “el diluyentes es agua”, lo cual debería leerse como “el diluyente es agua”. Se requiere una corrección apropiada.

Rechazo de las Reivindicaciones- 35 U.S.C. § 112- Segundo Párrafo

Lo siguiente es una cita de 35 U.S.C. 112(b):

(B) CONCLUSIÓN.- La Descripción debe concluir con una o más reivindicaciones particularmente señalando y reclamando distintivamente la materia de la cual el inventor o el inventor conjunto considera como la invención.

La siguiente es una cita de 35 U.S.C. 112(pre-AIA), segundo párrafo:

La descripción debe concluir con una o más reivindicaciones particularmente señalando y reclamando distintivamente la materia la cual el solicitante considera como su invención.

“El propósito primario de este requerimiento de definición del lenguaje de las reivindicaciones es asegurar que el alcance de las reivindicaciones es claro, de manera que el público es informado de los límites de lo que constituye la infracción de una patente. Un propósito secundario es proporcionar una medida clara de lo que los solicitantes consideran como la invención, de manera que pueda determinarse si la invención reclamada cumple

todos los criterios de patentabilidad y si la descripción cumple el criterio de 35 U.S.C. 112, primer párrafo con respecto a la invención reclamada.”, (ver MPE 35 § 2173).

Las Reivindicaciones 8-16 son rechazadas bajo 35 U.S.C. 112, segundo párrafo, al ser indefinidas por no señalar particularmente y reclamar distintivamente la materia, la cual el solicitante considera como su invención.

Las Reivindicaciones 8 y 9 dependen de la reivindicación 1 y recitan la limitación “donde el amortiguador de citrato está presente ...”. Existe base de antecedente insuficiente para esta limitación en las reivindicaciones porque la Reivindicación 1, de la cual dependen las reivindicaciones 8 y 9, no se refieren al amortiguador de citrato. Parece que estas reivindicaciones pueden haber tenido la intención de depender de la reivindicación 7, la cual menciona que el amortiguador (mencionado en la reivindicación 1), es un amortiguador de citrato.

Las reivindicaciones 21-22 son rechazadas bajo 35 U.S.C.112, segundo párrafo, al ser indefinidas por no señalar particularmente y reclamar distintivamente la materia, la cual el solicitante considera como su invención.

Las reivindicaciones 21 y 22 dependen de la reivindicación 1 y recita la limitación “donde la hidroxipropil β -ciclodextrina se encuentra presente...”. Existe base de antecedente insuficiente para esta limitación en las reivindicaciones porque la reivindicación 1, de la cual dependen las reivindicaciones 21 y 22, no menciona la hidroxipropil β -ciclodextrina. Parece que estas reivindicaciones pueden haber tenido la intención de depender de la reivindicación 18, la cual menciona que el agente espesante (mencionado en la reivindicación 1) es hidroxipropil β -ciclodextrina.

Las reivindicaciones 23-24 son rechazadas bajo 35 U.S.C.112, segundo párrafo, al ser indefinidas por no señalar particularmente y reclamar distintivamente la materia, la cual el solicitante considera como su invención.

Las reivindicaciones 23 y 24 dependen de la reivindicación 1 y menciona las limitaciones “...donde el ácido cítrico anhidro se encuentra presente...citrato de sodio anhidro se encuentra presente...y “...hidroxipropil β -ciclodextrina se encuentra presente...”. Existe base de antecedente insuficiente para estas limitaciones en las reivindicaciones porque la reivindicación 1, de la cual las reivindicaciones 23 y 24 dependen, no menciona el ácido cítrico anhidro, el citrato de sodio anhidro, o hidroxipropil β -ciclodextrina.

Las reivindicaciones 29-30 y 38-45 son rechazadas bajo 35 U.S.C.112, segundo párrafo, al ser indefinidas por no señalar particularmente y reclamar distintivamente la materia, la cual el solicitante considera como su invención.

Las reivindicaciones 29-30 dependen de la reivindicación 25 y menciona la limitación “...donde la solución acuosa...”. Existe base de antecedente insuficiente para estas

limitaciones en las reivindicaciones porque la reivindicación 25, de la cual dependen las reivindicaciones 29 y 30, no se menciona como solución acuosa.

La reivindicación 38 menciona un método que comprende administrar “la solución acuosa de la reivindicación 25”. Existe base de antecedente insuficiente para esta limitación en las reivindicaciones porque la reivindicación 25 no se menciona como solución acuosa.

La reivindicación 39 recita el método de la reivindicación 32 que comprende administrar “la solución acuosa intravenosa”. Existe base de antecedente insuficiente para esta limitación en las reivindicaciones porque la reivindicación 32 no se menciona como solución acuosa.

Las reivindicaciones 40-45 dependen directamente o indirectamente de la reivindicación 38 rechazada y por lo tanto también son indefinidas.

Las reivindicaciones 36 y 44 son rechazadas bajo 35 U.S.C.112, segundo párrafo, al ser indefinidas por no señalar particularmente y reclamar distintivamente la materia, la cual el solicitante considera como su invención.

Las reivindicaciones 36 y 44 dependen de las reivindicaciones 31 y 44 respectivamente y menciona la frase “otro agente activo secundario”. Existe una base de antecedente insuficiente para esta limitación en las reivindicaciones porque las reivindicaciones 31 y 44 de las dependen las reivindicaciones rechazadas, no menciona un (primer) agente activo secundario, por lo que no es claro como podría haber “otro” agente activo secundario. Parece que la palabra “otro” o “secundario” son superfluas en las reivindicaciones rechazadas.

Las reivindicaciones 37 y 45 son rechazadas bajo 35 U.S.C.112, segundo párrafo, al ser indefinidas por no señalar particularmente y reclamar distintivamente la materia, la cual el solicitante considera como su invención.

Las reivindicaciones 37 y 45 mencionan:

37. El método de la reivindicación 36, en donde el agente activo secundario es un anticuerpo terapéutico que se une específicamente a un antígeno de cáncer, factor de crecimiento hematopoyético, citocina, agente contra el cáncer, antibiótico, inhibidor cox-2, agente inmunomodulador, agente inmunosupresor, corticosteroide o una mutación farmacológicamente activa o derivado de esta.

45. El método de la reivindicación 44 en donde el agente activo secundario es un anticuerpo terapéutico que se une específicamente a un antígeno de cáncer, un factor de crecimiento hematopoyético, una citocina, un agente contra el cáncer, un antibiótico, un inhibidor cox-2, un agente inmunomodulador, un agente inmunosupresor, un corticosteroide o una mutación farmacológicamente activa o derivado de esta.

En primer lugar, no es claro si el Solicitante reclama un grupo Markush de agentes activos secundarios, es decir, cada uno de 1) un antígeno de cáncer, 2) un factor de crecimiento hematopoyético, 3) una citocina, 4) un agente contra el cáncer, 5) un antibiótico, 6) un inhibidor cox-2, 7) un agente inmunomodulador, 8) un agente inmunosupresor y 9) un corticosteroide o una mutación farmacológicamente activa o derivado de esta, son posibles selecciones de un agente activo secundario. O, es la intención del Solicitante que el agente activo secundario sea un anticuerpo terapéutico *que se une específicamente a* 1) un antígeno de cáncer, 2) un factor de crecimiento hematopoyético, 3) una citocina, 4) un agente contra el cáncer, 5) un antibiótico, 6) un inhibidor cox-2, 7) un agente inmunomodulador, 8) un agente inmunosupresor o 9) un corticosteroide o una mutación farmacológicamente activa o derivado de esta.

En segundo lugar, no es claro a qué se refiere con "...o una mutación farmacológicamente activa o derivado de esta". Por ejemplo, esto puede ser interpretado para aplicar únicamente al corticosteroide o puede ser interpretado para aplicar a todos los agentes recitados anteriormente. Esto se relaciona con el tema anterior porque si la intención del Solicitante es que el agente activo secundario sea un anticuerpo terapéutico *que se une específicamente a* 1) un antígeno de cáncer, 2) un factor de crecimiento hematopoyético, 3) una citocina, 4) un agente contra el cáncer, 5) un antibiótico, 6) un inhibidor cox-2, 7) un agente inmunomodulador, 8) un agente inmunosupresor o 9) un corticosteroide, entonces "...o una mutación farmacológicamente activa o derivado de esta" puede ser únicamente interpretado para aplicar al anticuerpo terapéutico.

En tercer lugar, sin importar a qué se refiera "...o una mutación farmacológicamente activa o derivado de esta", el término "derivado" es un término relativo el cual hace que la reivindicación sea indefinida. Particularmente, "derivado" no señala particularmente el grado o tipo de derivación que un anticuerpo, enzima, o compuesto dado pueda tener en relación con el anticuerpo padre, enzima, o compuesto y aún se consideraría un "derivado" como pretenden los Solicitantes. Los Solicitantes han fallado en proporcionar alguna definición específica para este término en la presente descripción. El Examinador reconoce la discusión del Solicitante en [0225] de la solicitud publicada donde los ejemplos de los derivados incluyen, pero no se limitan a, derivados pegilados y proteínas de fusión, tales como proteínas formadas mediante la fusión de IgG1 o IgG3 a la proteína o la parte activa de la proteína de interés. Sin embargo, dicha descripción únicamente proporciona ejemplos no-limitativos de dichos derivados. Falta limitar la definición, la persona normalmente versada en la materia no estaría razonablemente informado de las medidas y los límites de la materia para la cual los Solicitantes buscan protección por patente. Más bien, se requeriría una interpretación subjetiva del lenguaje reivindicado. Sin embargo, como tal se considera inconsistente con el contenido y el lenguaje expreso de 35 U.S.C § 112, segundo párrafo, las reivindicaciones se consideran debidamente rechazadas.

Materia Concedida

Las reivindicaciones 1, 4-7, 17-20, 25, 27-28 y 31-35 son concedidas.

Lo siguiente es una declaración de razones para la indicación de materia concedida. El arte previo no enseña o sugiere razonablemente el compuesto 2-(4-clorofenil)-N-((2-(2,6-dioxopiperidin-3-il)-1-oxoisindolin-5-il)metil)-2,2-difluoroacetamida tal y como se encuentra mencionada en las presentes reivindicaciones. Es así que, las formulaciones liofilizadas que comprenden el compuesto reclamado tal y como se encuentra mencionado en las presentes reivindicaciones son novedosas y no-obvias.

El arte previo cercano que divulga el compuesto reclamado es US 2016/0009683 A1 (Publicado Enero 14, 2016; Presentado Julio 11, 2014). Esta referencia no se encuentra disponible como arte previo bajo 35 U.S.C.102(a)(1) porque fue publicada después de la primera fecha de presentación del Solicitante (Enero 8, 2016). Esta referencia no aplica bajo 35 U.S.C.102(a)(2) porque es una divulgación de propiedad común y, por lo tanto, califica como una excepción en virtud de 35 U.S.C.102(b)(2).

Conclusión

Las reivindicaciones 1, 4-7, 17-20, 25, 27-28 y 31-35 son concedidas.

Las reivindicaciones 8-16, 21-24, 29-30 y 36-45 son rechazadas.

Las reivindicaciones 2-3 y 46 están objetadas.

Si el solicitante modifica las reivindicaciones, una respuesta completa y receptiva podrá claramente identificar donde puede encontrarse el soporte en la divulgación de cada modificación. Los solicitantes deberán indicar la página y el número de líneas de la solicitud correspondiente con cada modificación, y proporcionar alguna declaración que puedan ayudar a identificar el soporte de la invención reclamada (por ejemplo, si la modificación no está soportada en *ipsis verbis*, una aclaración en el registro ayudaría). Si los Solicitantes presente nuevas reivindicaciones, los Solicitantes deberían identificar con claridad en donde puede encontrarse el soporte en cada divulgación.

Cualquier pregunta relacionada a esta comunicación o anteriores comunicaciones por parte del Examinador deben ser dirigidas a JAMES D ANDERSON cuyo teléfono es (571)272-9038. El Examinador puede ser normalmente encontrado de Lunes-Viernes, 8:30 am-5:00 pm.

Si se intenta contactar con el examinador por teléfono y no tiene éxito, el supervisor del examinador, Jeffrey Lundgren puede ser encontrado en el 571-272-5541. El número telefónico de fax para la organización donde esta solicitud o proceso está asignado es 571-273-8300.

Información relacionada con el estado de una solicitud debe ser obtenido del Sistema de Recuperación de Información de solicitud de patente (PAIR). Información de estado para solicitudes publicadas pueden ser obtenidas de PAIR privado o PAIR público.

Información de estado para solicitudes no publicadas se encuentra disponible únicamente a través de PAIR privado. Para mayor información sobre el sistema PAIR ver <http://pair-direct.uspto.gov>. Si tiene preguntas sobre el acceso al sistema privado PAIR, contactar el Centro de negocios electrónico (EBC) en el 866-217-9197. Si a usted le gustaría asistencia de un representante de servicio al cliente de la USPTO o acceso al sistema de información automatizado, llamar al 800-786-9199 (en USA o Canadá) o 571-272-1000.

/James D. Anderson/

James D. Anderson, Ph.D.

Examinador de Patentes Primario

Oficina de Patentes y Marcas de Estados Unidos

400 Dulany Street

Alexandria, VA 22314-5774

Tel. No.: (571) 272-9038

AVISO DE CONCESIÓN Y TASA(S) CORRESPONDIENTES

Nota del Estado de Pre-AIA o AIA

La presente solicitud, presentada en o después de Marzo 16 de 2013, es examinada bajo el primer inventor para presentar disposiciones de la AIA.

Estado de las Reivindicaciones

La respuesta al Solicitante y modificaciones a las reivindicaciones, presentadas el 01/10/2018, han sido recibidas e introducidas.

Las Reivindicaciones 47-50 son nuevas agregadas.

Las Reivindicaciones 1-50 son las actualmente presentadas y concedidas.

Modificaciones del Examinador

Abajo aparece un registro de la modificación del Examinador. Si los cambios y/o adiciones son inaceptables para el solicitante, una modificación debe presentarse tal y como lo dispone el 37 CFR 1.312. Para asegurar la consideración de dicha modificación, la misma DEBE presentarse hasta el pago de la tasa de emisión.

La autorización para la modificación del examinador fue dada en una entrevista con Megha Bhumralkar en Abril 6, 2018.

La solicitud ha sido modificada como sigue:

48. (Modificada) El método de la reivindicación 47, en donde la malignidad hematológica es leucemia mielógena aguda, leucemia linfocítica aguda, leucemia de linfocitos T en adultos, leucemia linfocítica crónica, leucemia de células pilosas, mielodisplasia, trastorno mieloproliferativo, leucemia mielógena crónica, síndrome mielodisplásico, leucemia tipo 1 del virus linfotrópico humana, mastocitosis o leucemia linfoblástica aguda de células B. ~~En algunas modalidades, el linfoma es, por ejemplo,~~ linfoma difuso de células B grandes, linfoma inmunoblástico de linfocitos B, linfoma de células pequeñas no hendidas, leucemia/linfoma tipo 1 del virus linfotrópico humano, linfoma de linfocitos T en adultos, linfoma de células T periféricos (PTCL), linfoma cutáneo de células T, linfoma de células del manto, linfoma de Hodgkin, linfoma no Hodgkin, linfoma relacionado con células-T/histiocitos, linfoma transformado, linfoma de células B grandes mediastinal primario, linfoma de la zona marginal esplénica, transformación de Richter, linfoma de la zona marginal nodal o linfoma de células B grandes positivo para ALK.

Conclusión

Las reivindicaciones 1-50 son concedidas.

Cualquier pregunta relacionada a esta comunicación o anteriores comunicaciones por parte del Examinador deben ser dirigidas a JAMES D ANDERSON cuyo teléfono es (571)272-9038. El Examinador puede ser normalmente encontrado de Lunes-Viernes, 8:30 am-5:00 pm.

Las entrevistas con el examinador están disponibles vía telefónica, en persona, y mediante video conferencia utilizando una herramienta de colaboración basada en la web provista por LA USPTO. Para programar una entrevista, se recomienda al solicitante que use la Solicitud de entrevista automatizada de la USPTO (AIR) en <http://www.uspto.gov/interviewpractice>.

Si se intenta contactar con el examinador por teléfono y no tiene éxito, el supervisor del examinador, Jeffrey Lundgren puede ser encontrado en el 571-272-5541. El número telefónico de fax para la organización donde esta solicitud o proceso está asignado es 571-273-8300.

Información relacionada con el estado de una solicitud debe ser obtenido del Sistema de Recuperación de Información de solicitud de patente (PAIR). Información de estado para solicitudes publicadas pueden ser obtenidas de PAIR privado o PAIR público. Información de estado para solicitudes no publicadas se encuentra disponible únicamente a través de PAIR privado. Para mayor información sobre el sistema PAIR ver <http://pair-direct.uspto.gov>. Si tiene preguntas sobre el acceso al sistema privado PAIR, contactar el Centro de negocios electrónico (EBC) en el 866-217-9197. Si a usted le gustaría asistencia de un representante de servicio al cliente de la USPTO o acceso al sistema de información automatizado, llamar al 800-786-9199 (en USA o Canadá) o 571-272-1000.

/James D. Anderson/

Examinador de Patentes Primario



US010052315B2

(12) **United States Patent**
Hui et al.

(10) **Patent No.:** US 10,052,315 B2
(45) **Date of Patent:** Aug. 21, 2018

(54) **FORMULATIONS OF
2-(4-CHLOROPHENYL)-N-((2-(2,6-
DIOXOPIPERIDIN-3-YL)-1-
OXOISOINDOLIN-5-YL)METHYL)-2,2-
DIFLUOROACETAMIDE**

(71) Applicant: **Celgene Corporation**, Summit, NJ
(US)

(72) Inventors: **Ho-Wah Hui**, Basking Ridge, NJ (US);
Yu Pu, East Hanover, NJ (US)

(73) Assignee: **Celgene Corporation**, Summit, NJ
(US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

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Primary Examiner — James D. Anderson
(74) Attorney, Agent, or Firm — Jones Day

(21) Appl. No.: **15/400,791**

(22) Filed: **Jan. 6, 2017**

(65) Prior Publication Data

US 2017/0196847 A1 Jul. 13, 2017

Related U.S. Application Data

(60) Provisional application No. 62/276,756, filed on Jan.
8, 2016.

(51) Int. Cl.

A61K 31/454 (2006.01)
A61K 9/00 (2006.01)
A61K 9/08 (2006.01)
A61K 9/19 (2006.01)
A61K 39/395 (2006.01)
A61K 47/12 (2006.01)
A61K 47/40 (2006.01)
C07K 16/00 (2006.01)
A61K 39/00 (2006.01)

(52) U.S. Cl.

CPC *A61K 31/454* (2013.01); *A61K 9/0019*
(2013.01); *A61K 9/0095* (2013.01); *A61K 9/08*
(2013.01); *A61K 9/19* (2013.01); *A61K 39/395*
(2013.01); *A61K 47/12* (2013.01); *A61K 47/40*
(2013.01); *C07K 16/00* (2013.01); *A61K*
2039/505 (2013.01)

(58) Field of Classification Search

CPC *A61K 31/454*
See application file for complete search history.

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(57) ABSTRACT

Provided herein are lyophilized formulations of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide or a stereoisomer or mixture of stereoisomers, pharmaceutically acceptable salt, tautomer, prodrug, solvate, hydrate, co-crystal, clathrate, or polymorph thereof. Methods of using the formulations and dosage forms for treating, managing, and/or preventing cancer are also provided herein.

50 Claims, 34 Drawing Sheets

(56)

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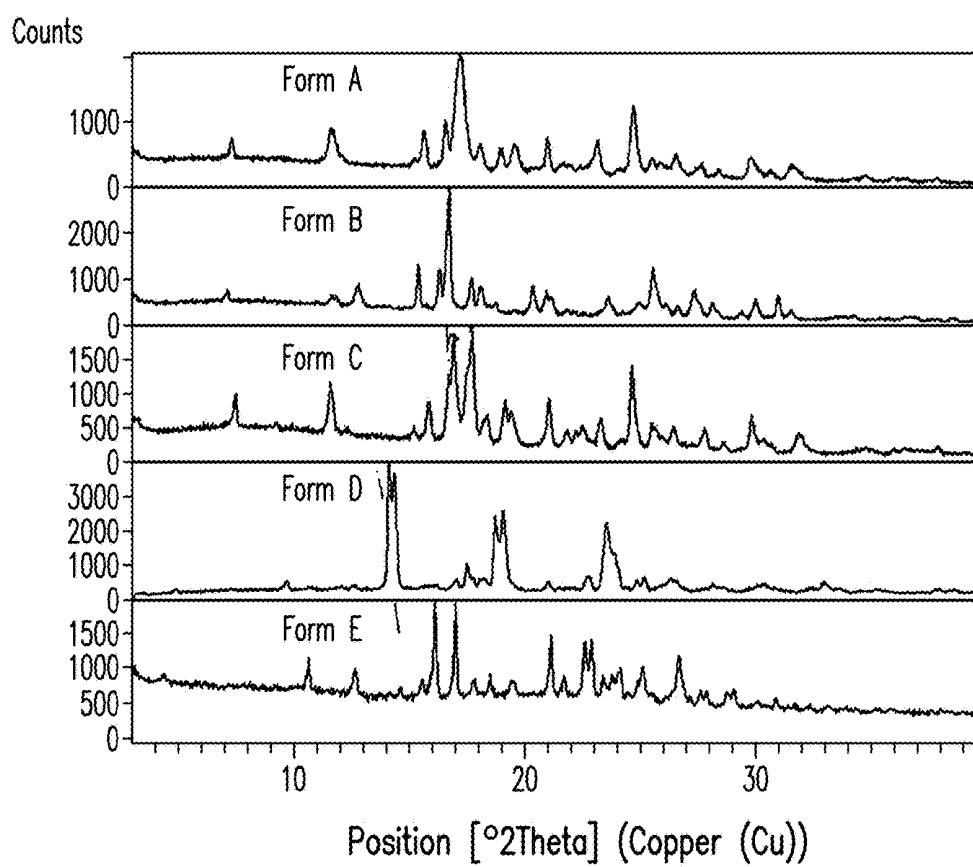


FIG. 1

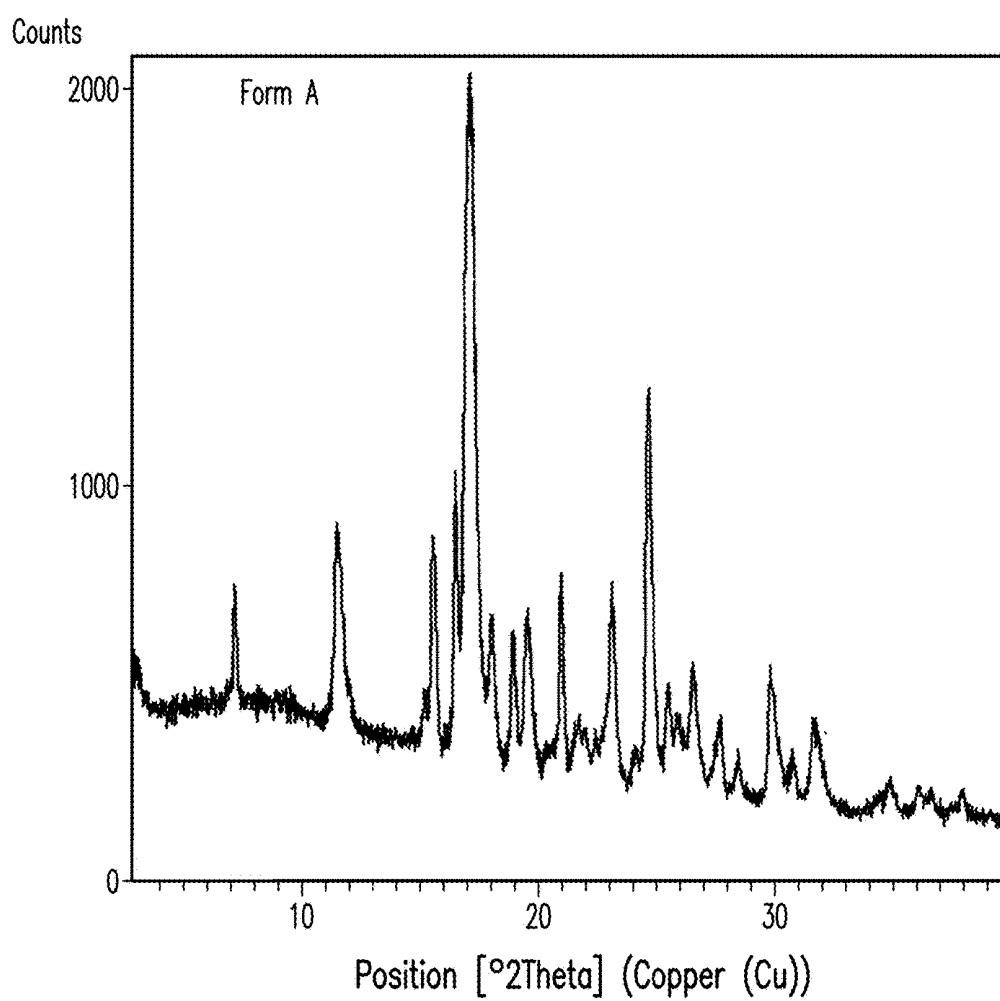


FIG. 2

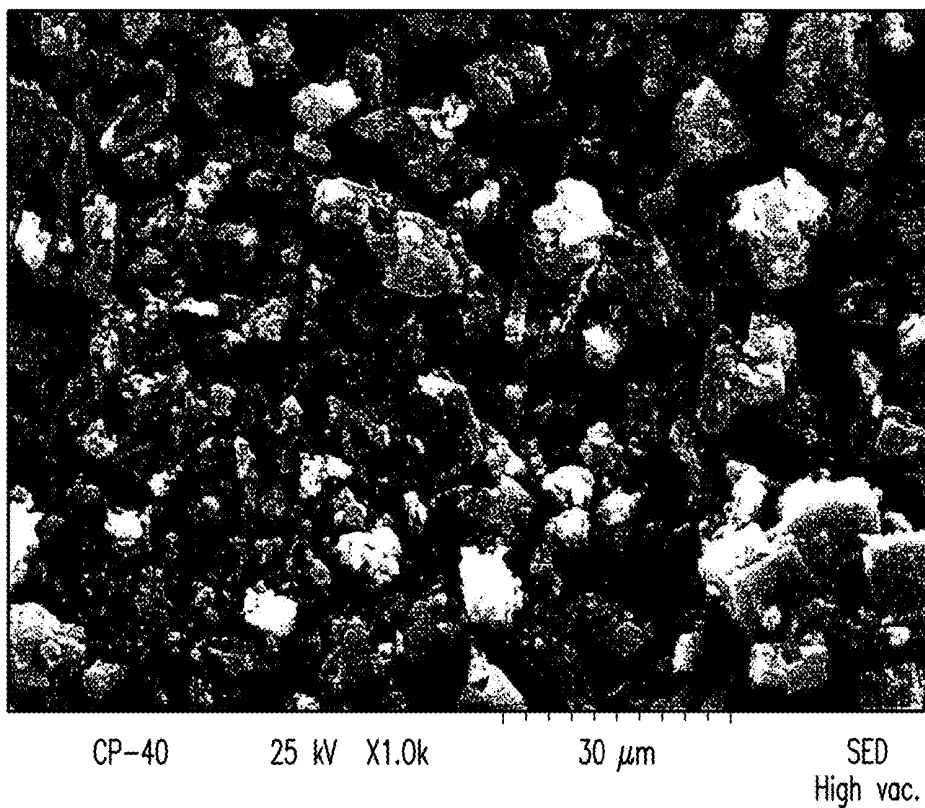


FIG. 3

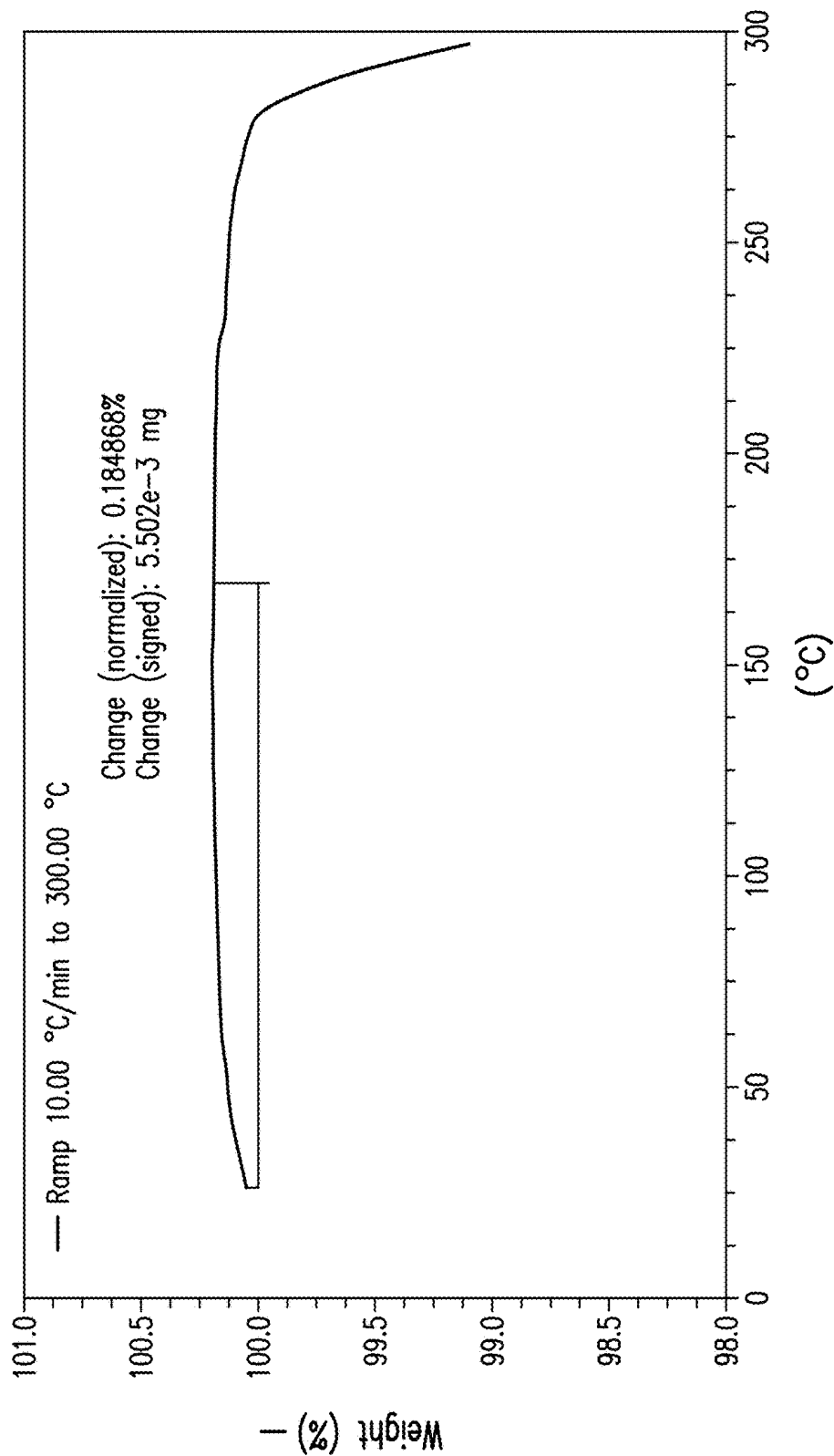


FIG. 4

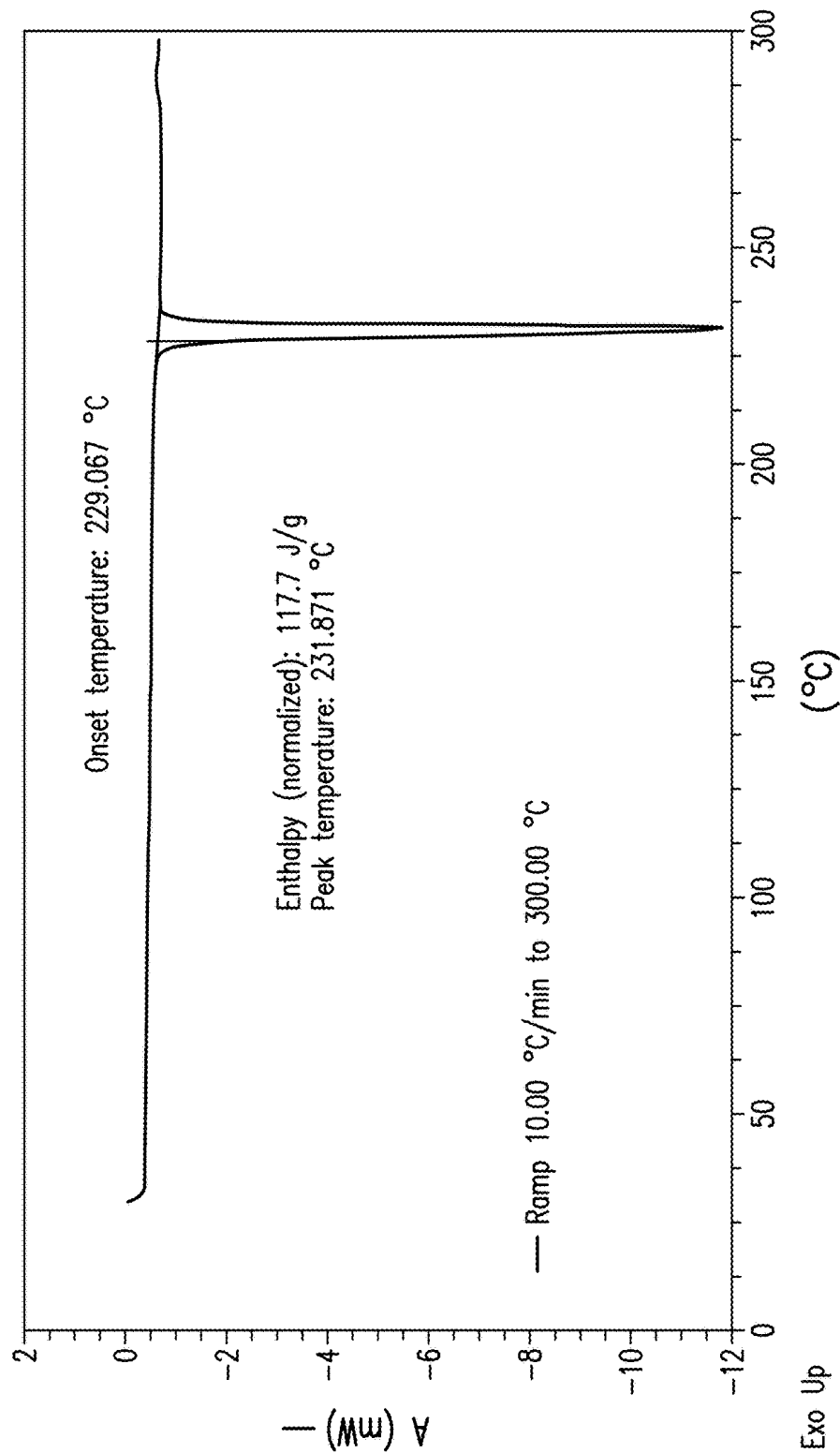
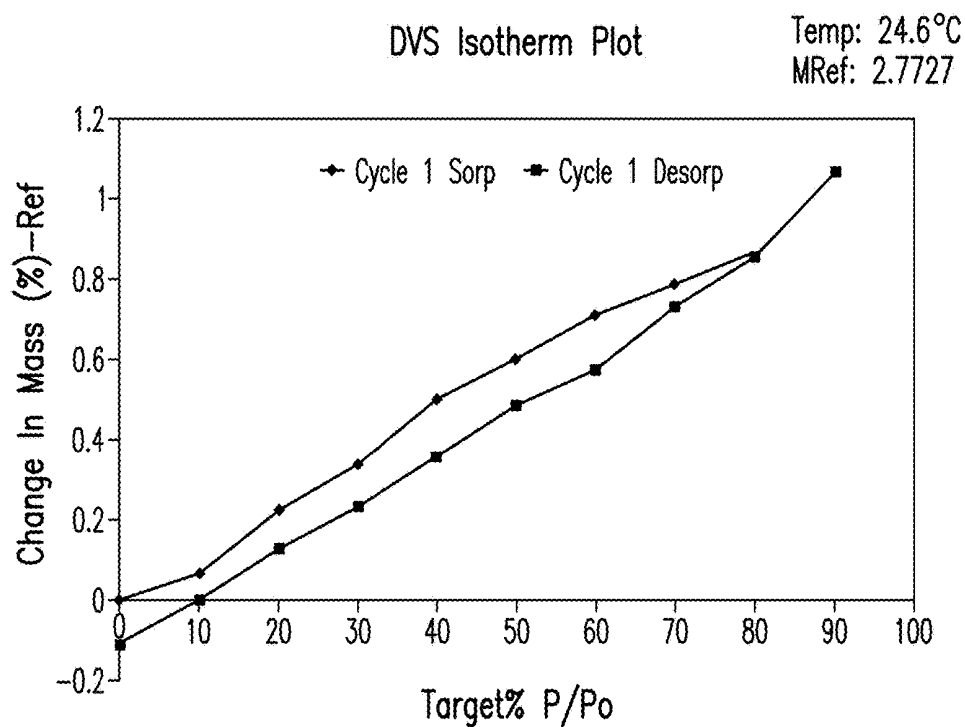


FIG. 5



	Target % P/Po	Change In Mass (%) - ref		Hysteresis
		Sorption	Desorption	
Cycle 1	0.0	-0.004	-0.111	
	10.0	0.063	-0.002	-0.066
	20.0	0.221	0.126	-0.094
	30.0	0.339	0.231	-0.108
	40.0	0.509	0.360	-0.149
	50.0	0.614	0.496	-0.118
	60.0	0.726	0.586	-0.139
	70.0	0.808	0.751	-0.057
	80.0	0.887	0.880	-0.007
	90.0	1.099	1.099	

FIG. 6

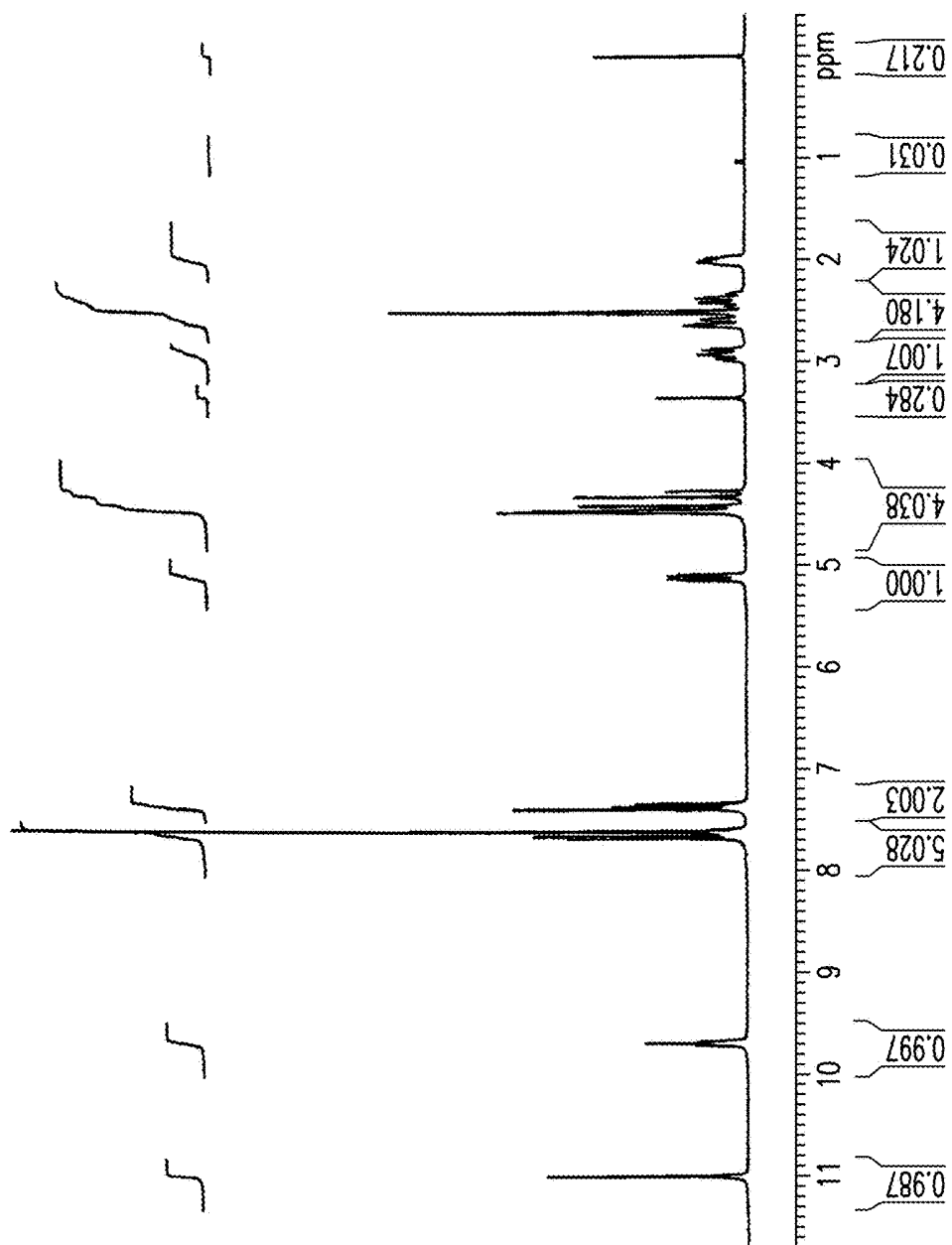


FIG. 7

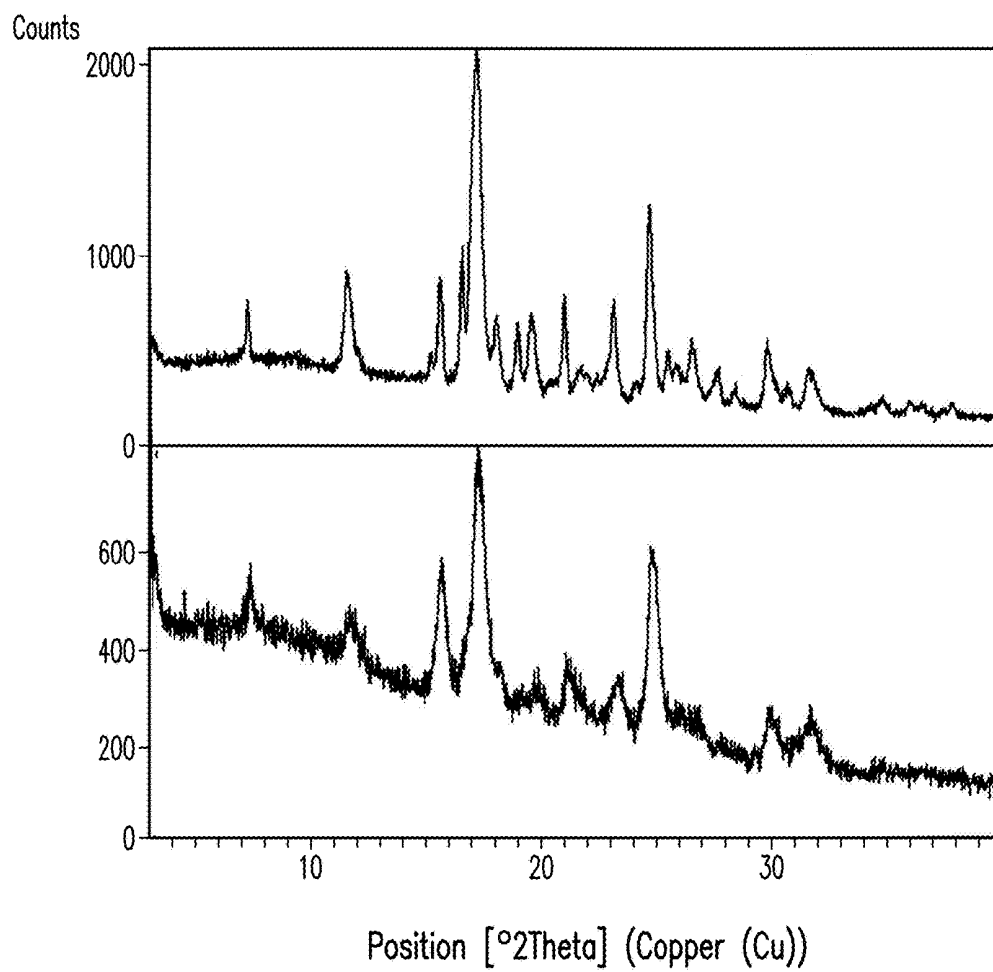


FIG. 8

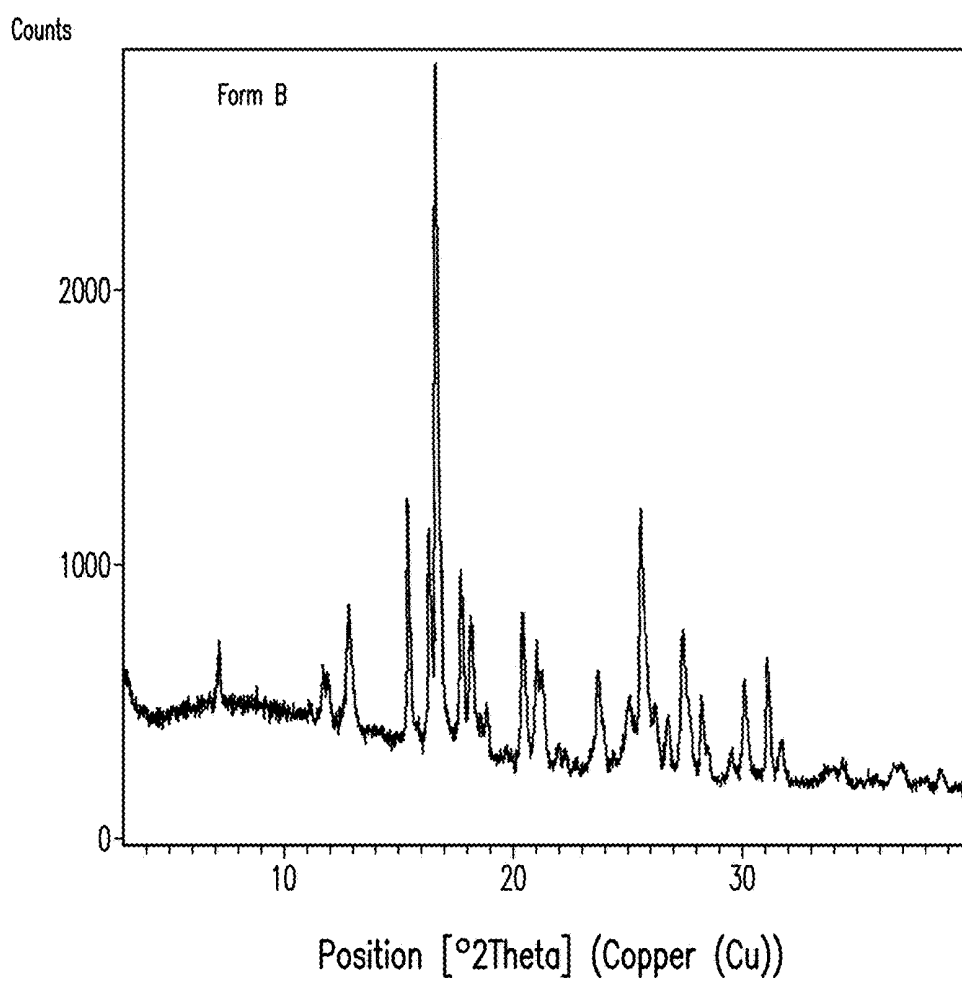
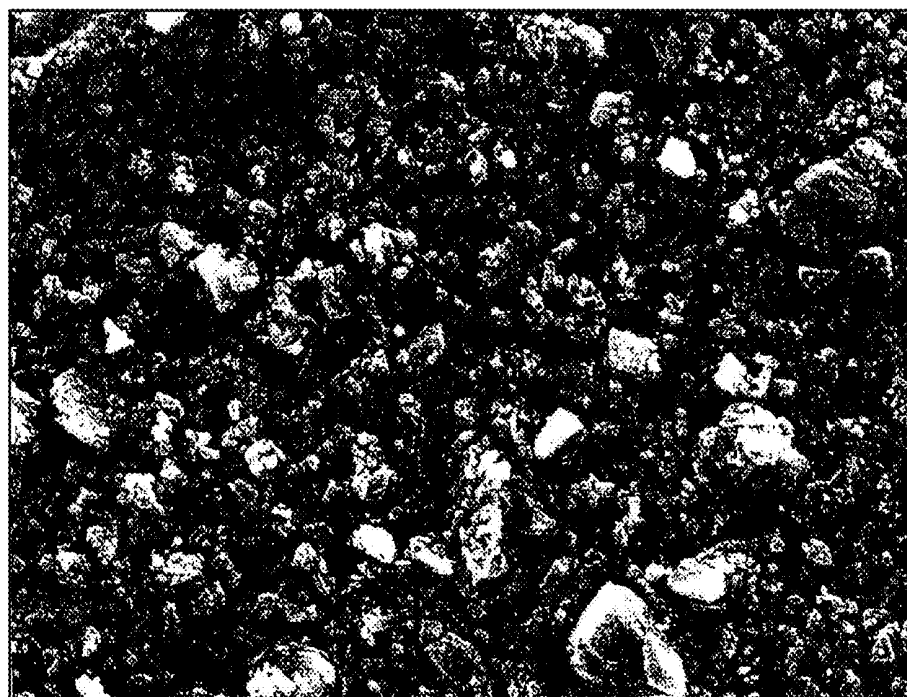


FIG. 9



CP-40

25 kV xl. 0k

30 μ m

SED
High vac.

FIG. 10

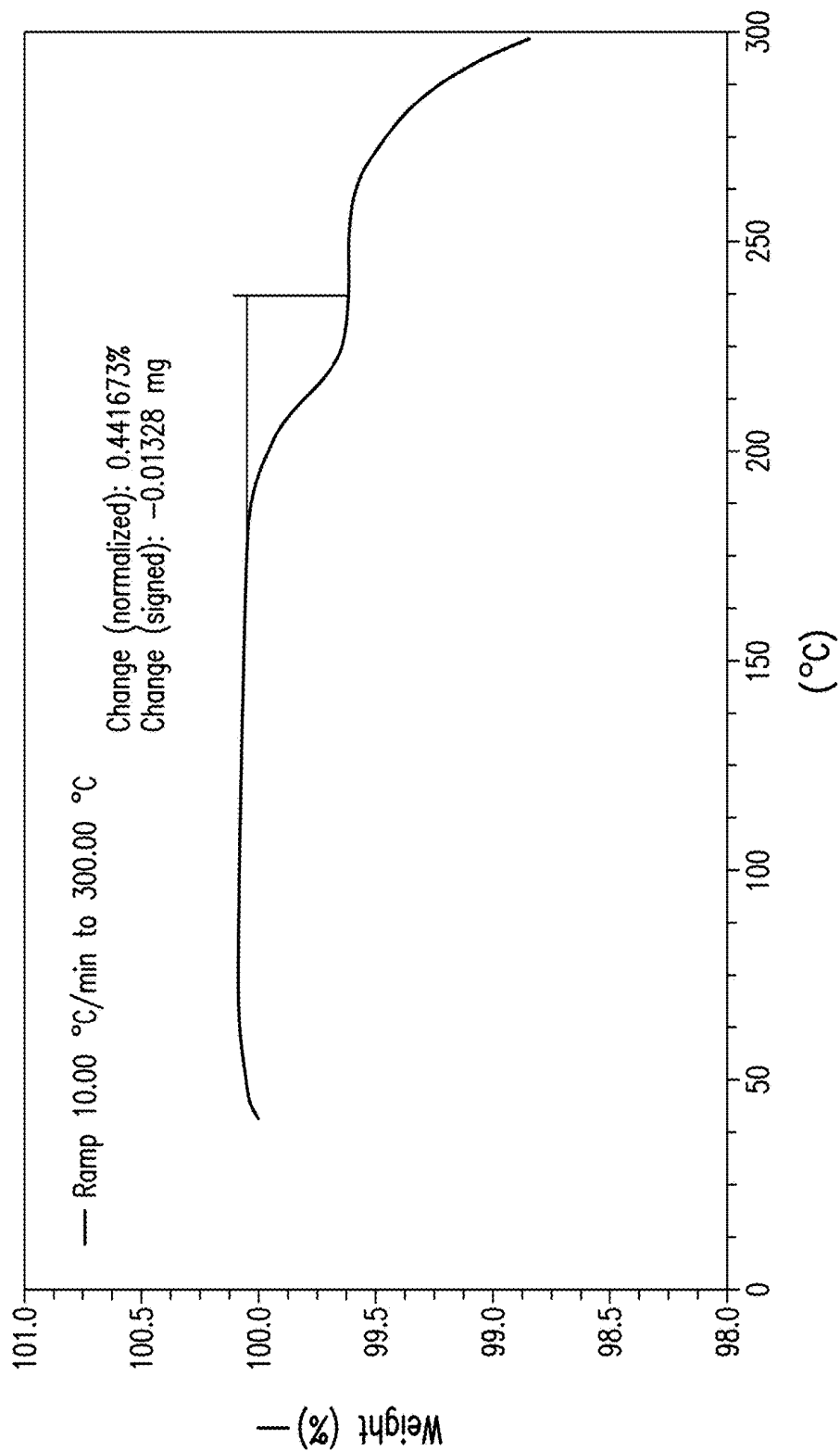


FIG. 11

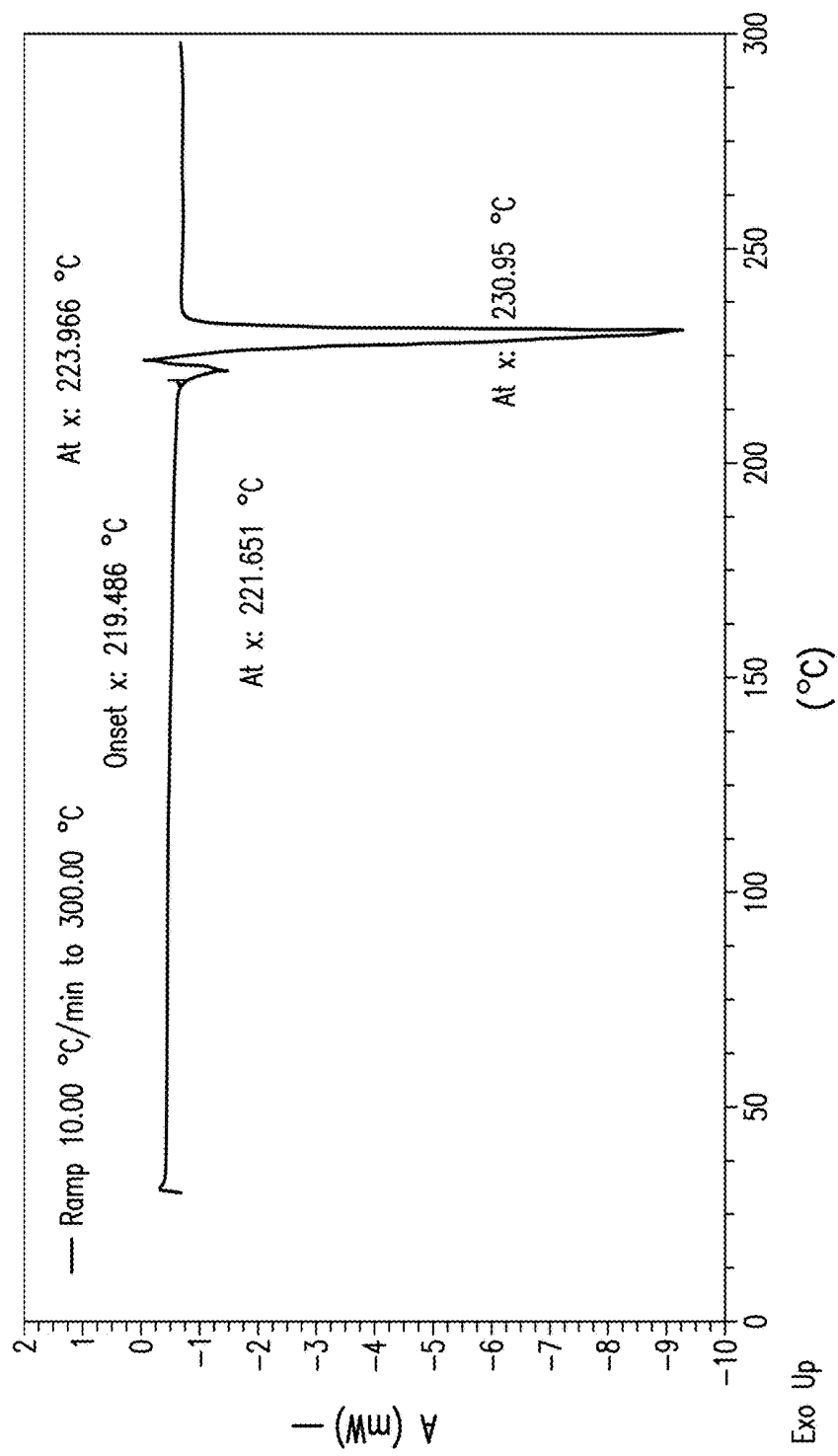
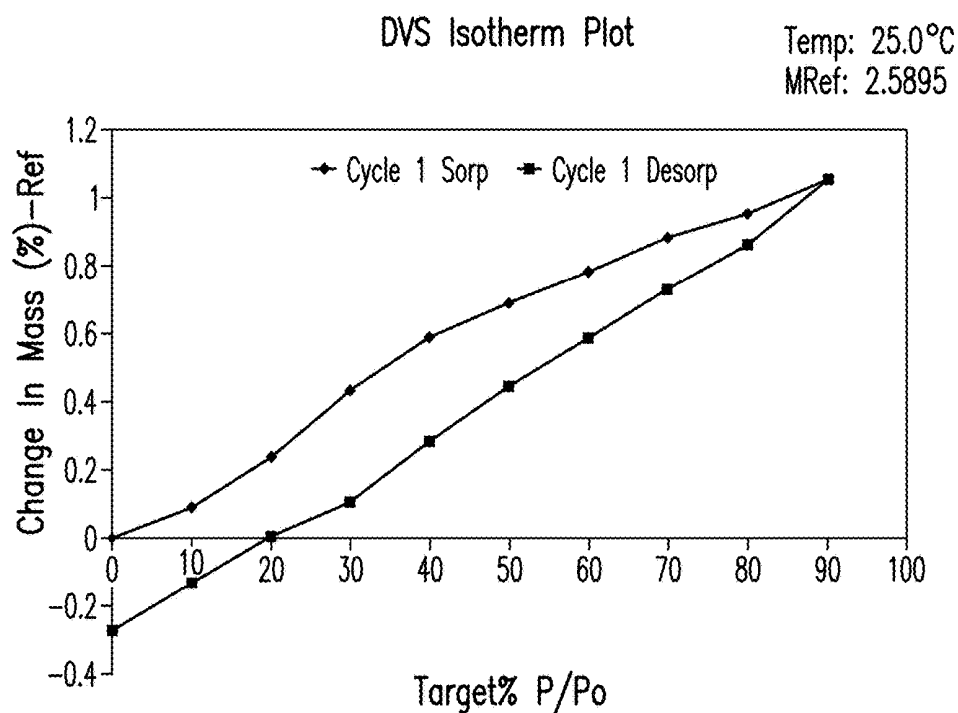
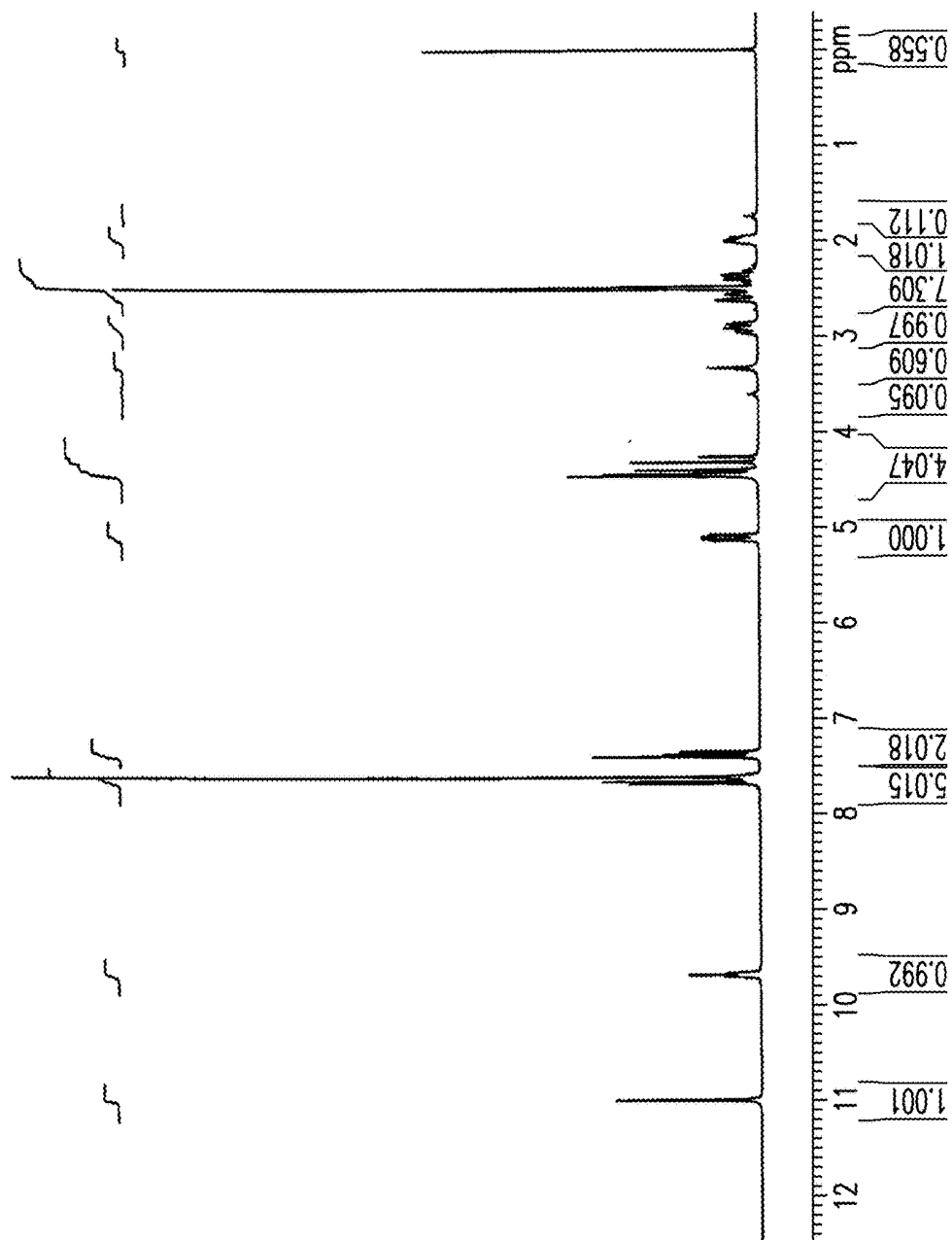


FIG. 12



	Target % P/Po	Change In Mass (%) - ref		Hysteresis
		Sorption	Desorption	
Cycle 1	0.0	0.000	-0.270	
	10.0	0.093	-0.120	-0.213
	20.0	0.241	0.009	-0.232
	30.0	0.439	0.112	-0.327
	40.0	0.595	0.292	-0.303
	50.0	0.700	0.456	-0.244
	60.0	0.798	0.599	-0.198
	70.0	0.903	0.748	-0.154
	80.0	0.977	0.886	-0.091
	90.0	1.085	1.085	

FIG. 13



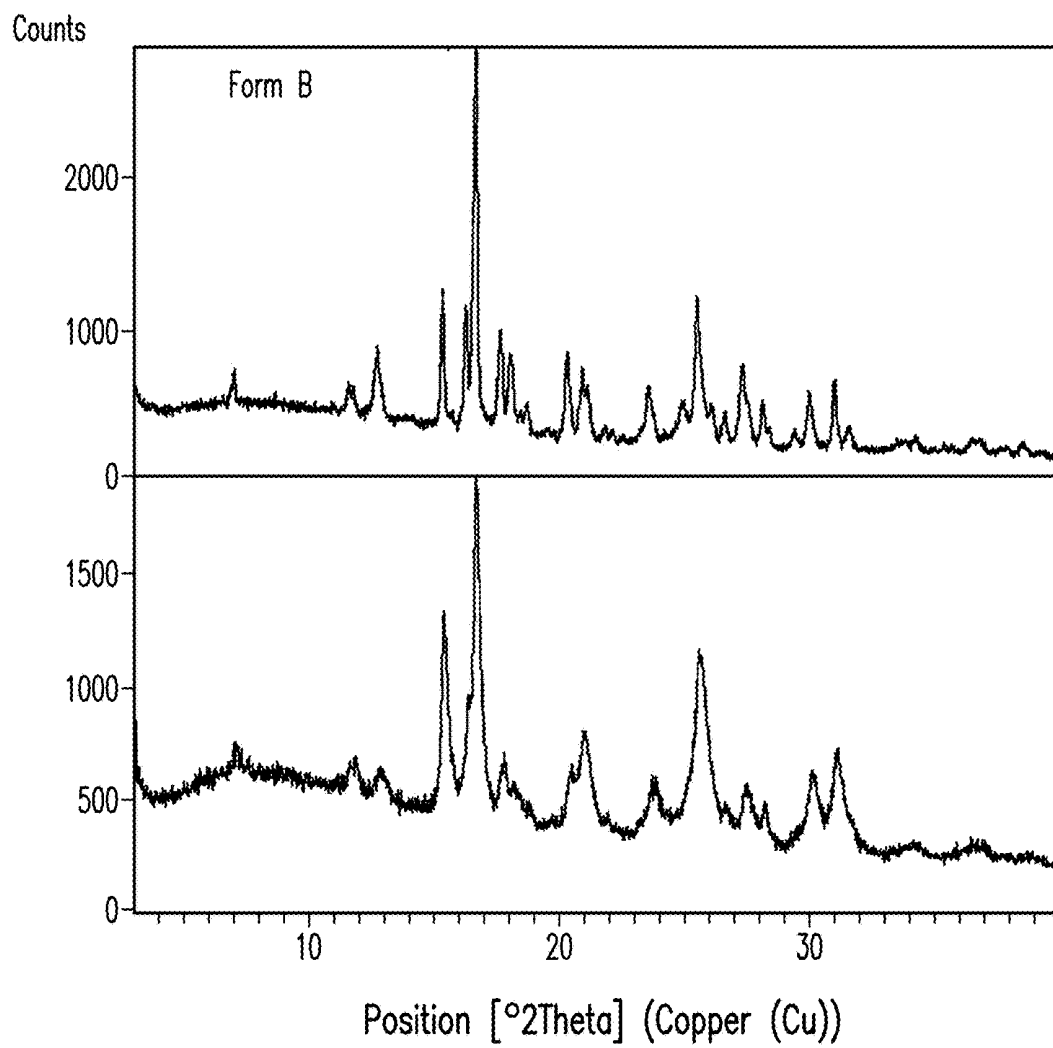


FIG. 15

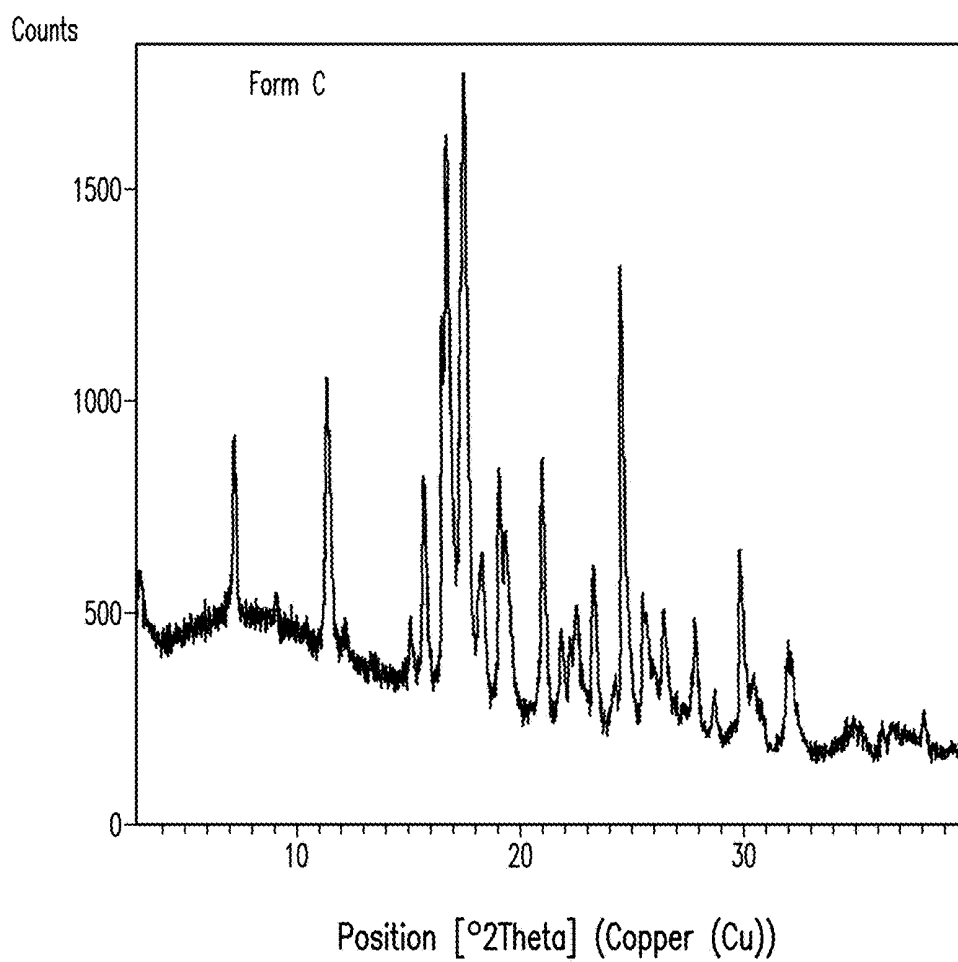


FIG. 16

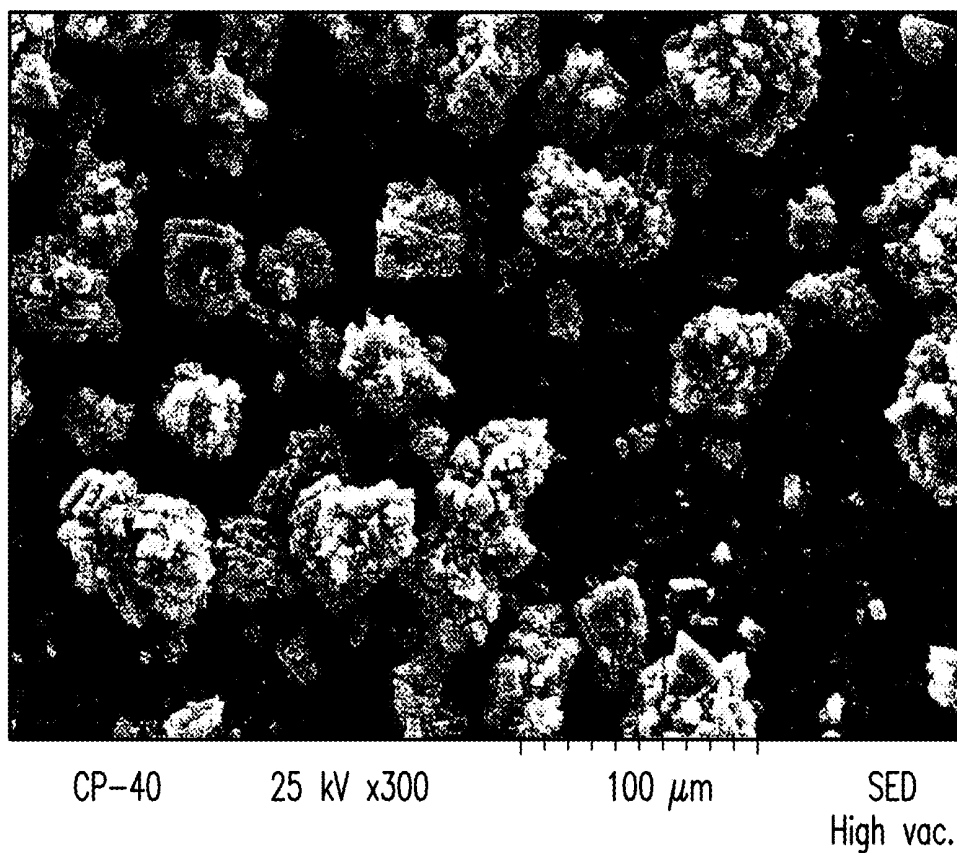


FIG. 17

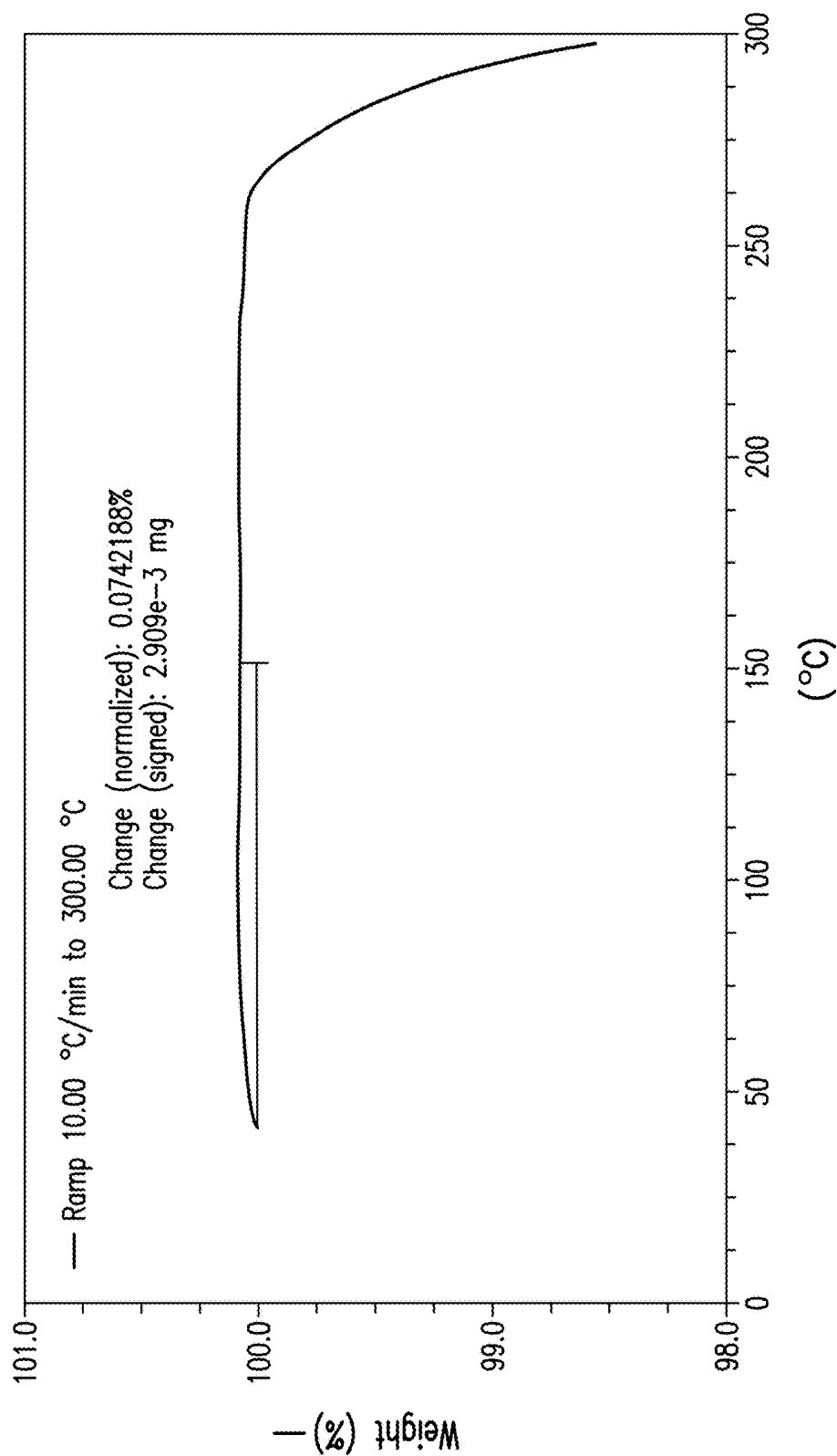


FIG. 18

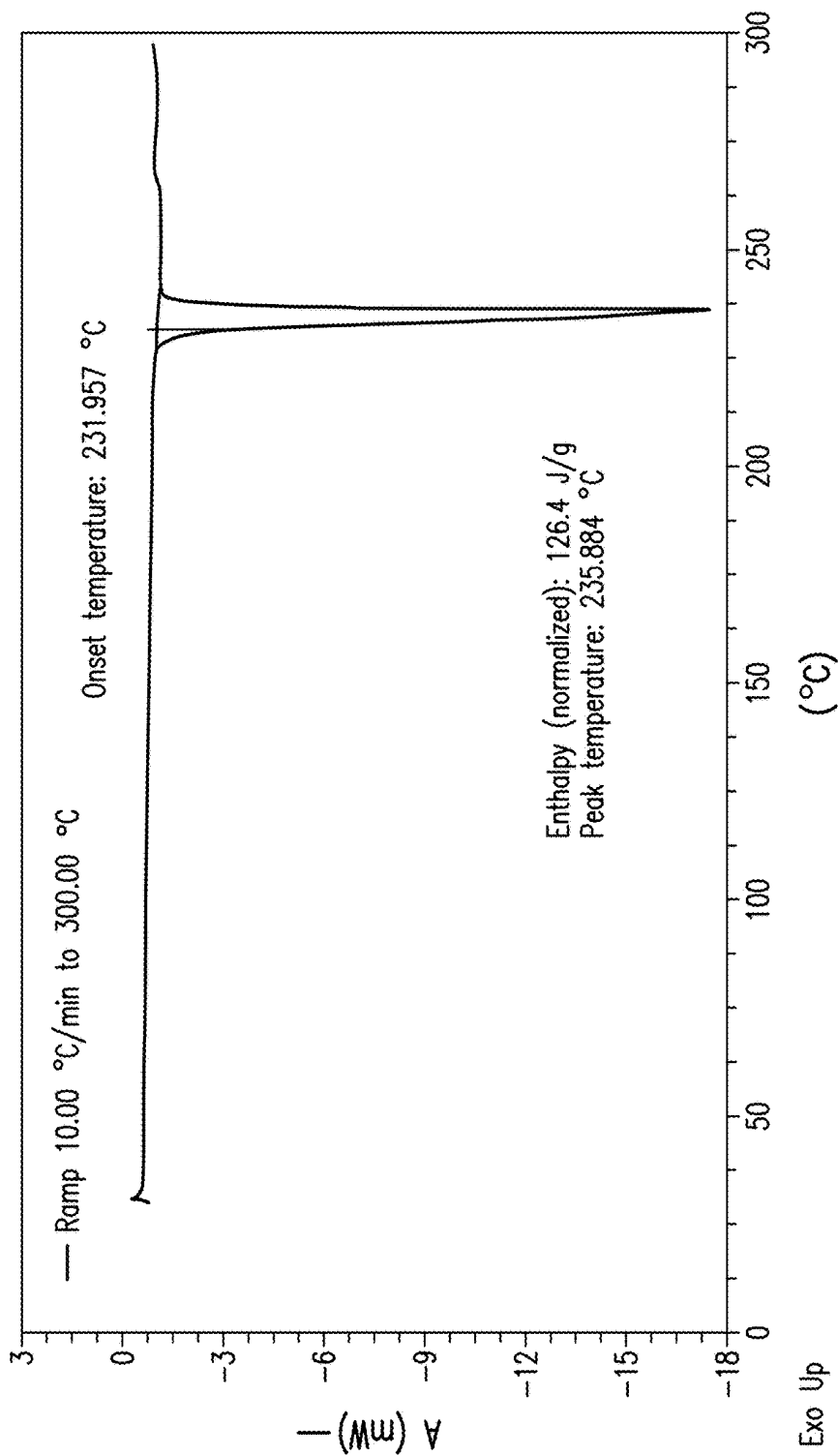
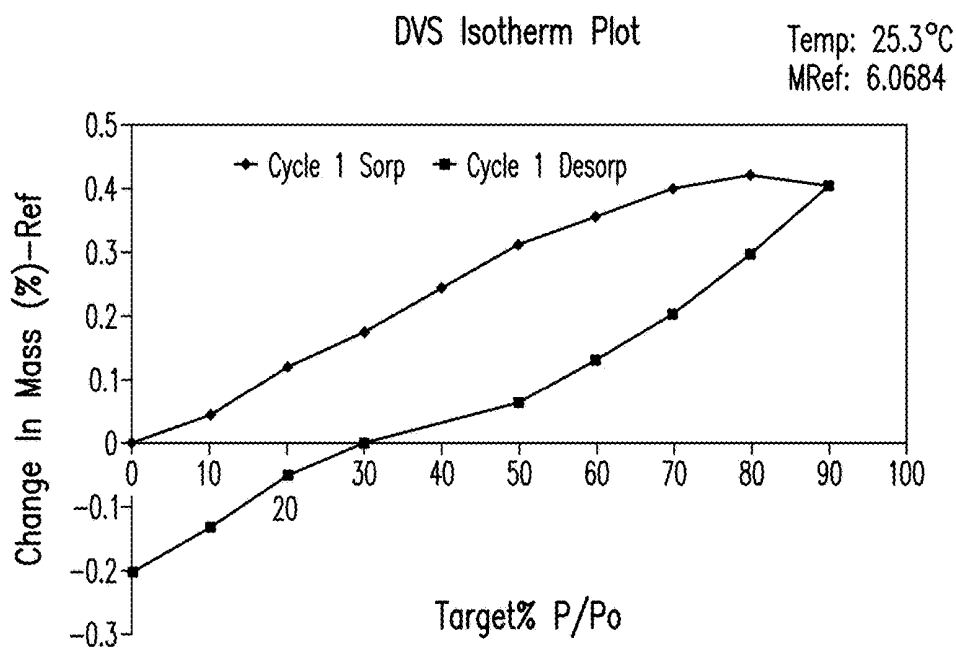
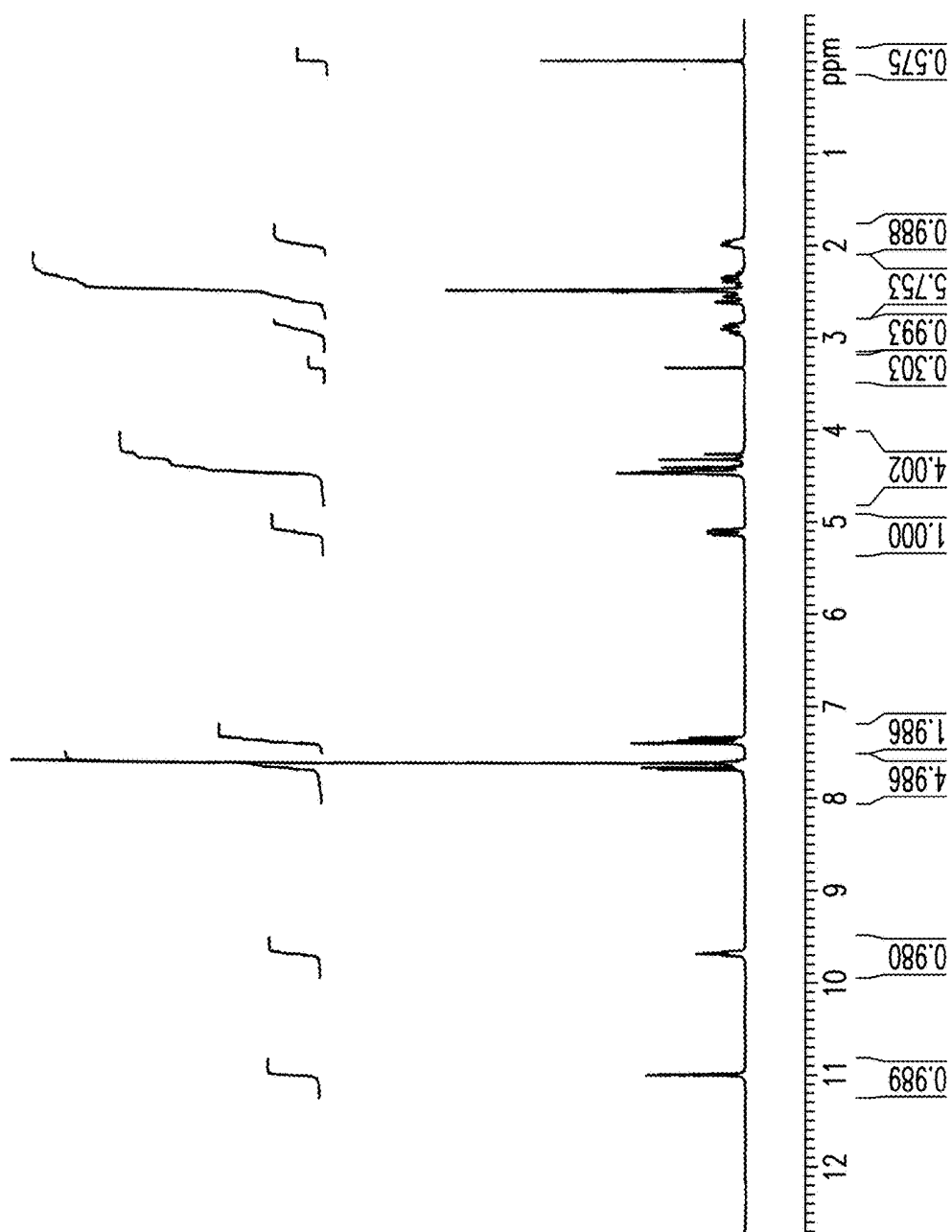


FIG. 19



	Target % P/Po	Change In Mass (%) - ref		
		Sorption	Desorption	Hysteresis
Cycle 1	0.0	-0.0020	-0.2070	
	10.0	0.0409	-0.1368	-0.1776
	20.0	0.1186	0.0547	-0.1734
	30.0	0.1730	0.0049	-0.1780
	40.0	0.2409	0.0395	-0.2805
	50.0	0.3114	0.0606	-0.2508
	60.0	0.3559	0.1305	-0.2254
	70.0	0.4014	0.2027	-0.1987
	80.0	0.4235	0.2983	-0.1252
	90.0	0.4087	0.4087	

FIG. 20



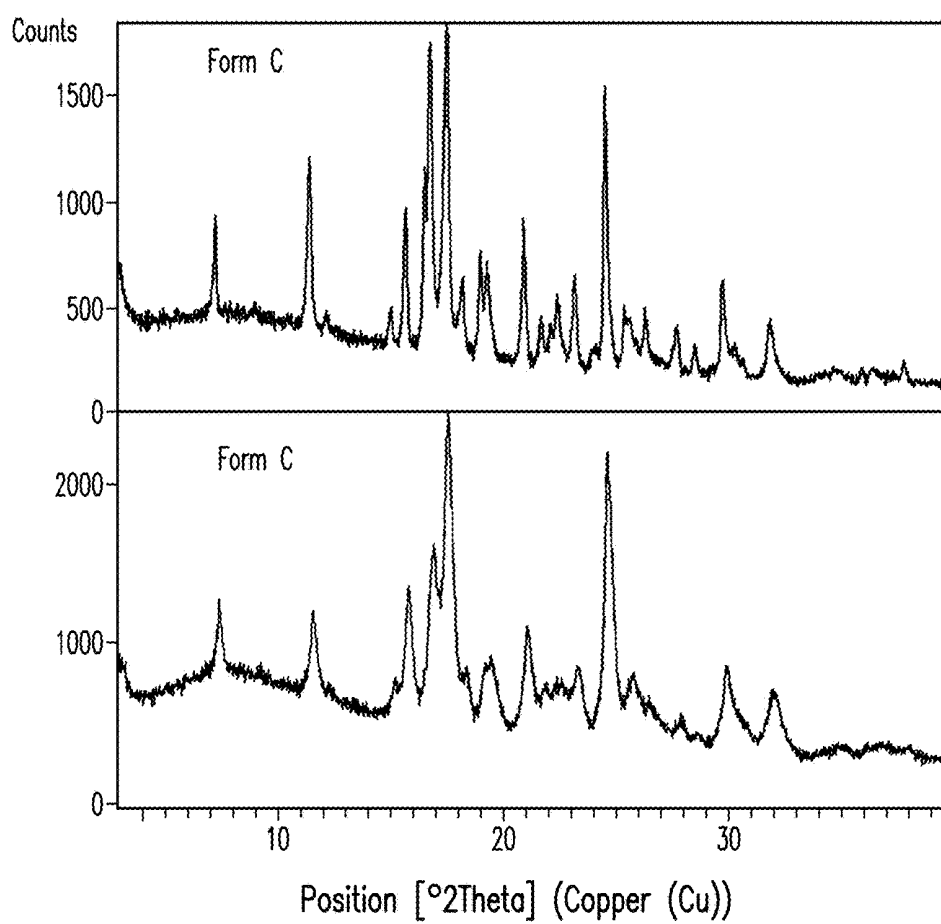


FIG. 22

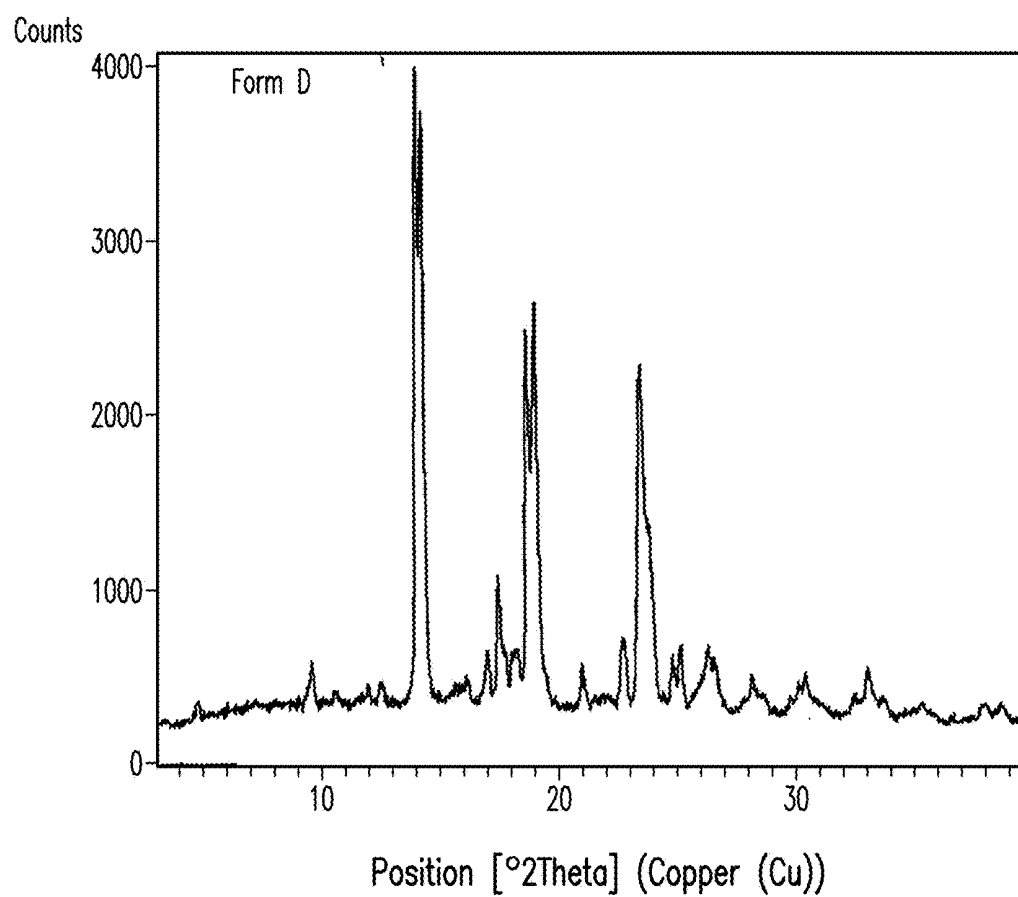


FIG. 23

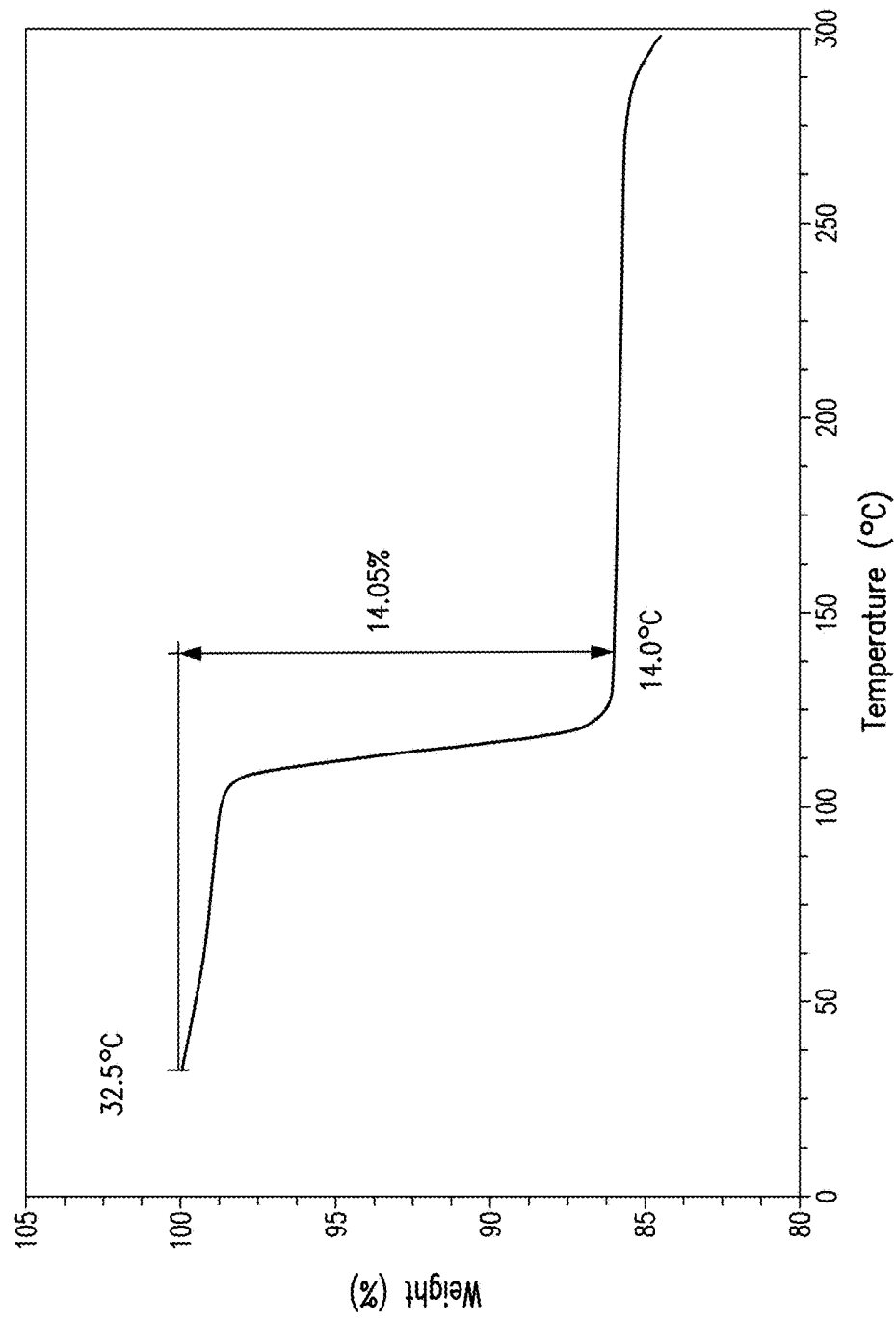


FIG. 24

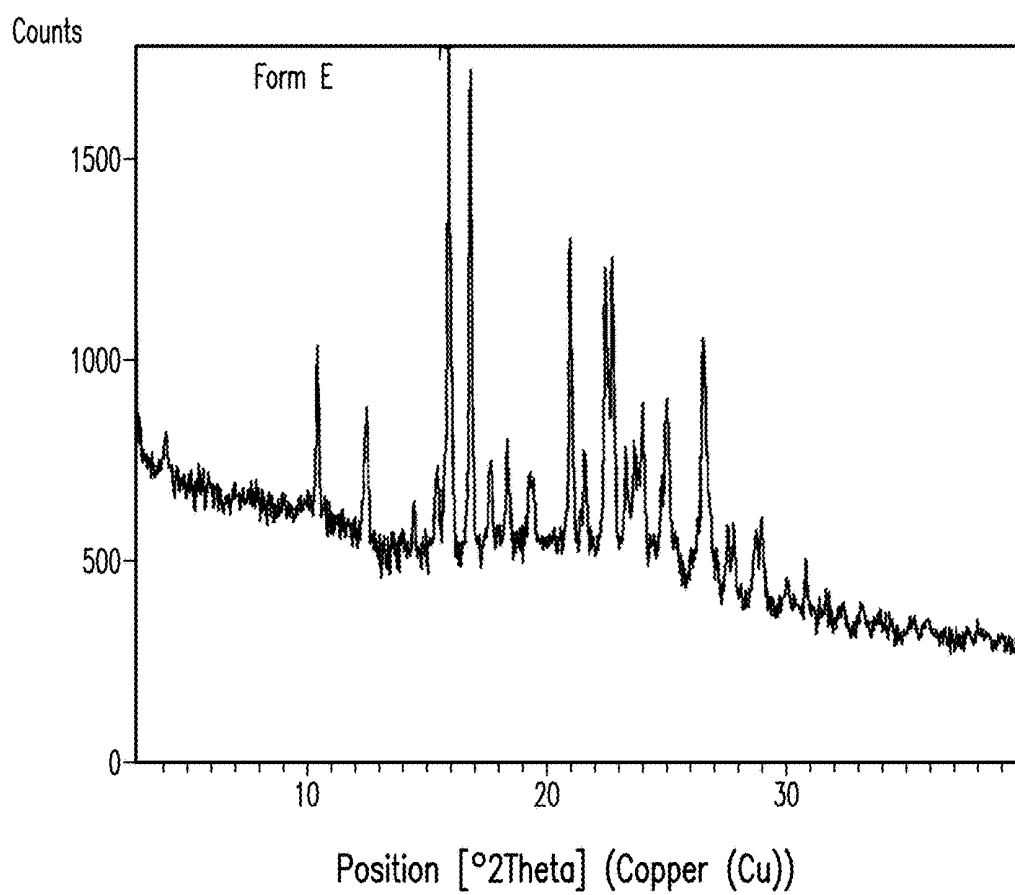


FIG. 25

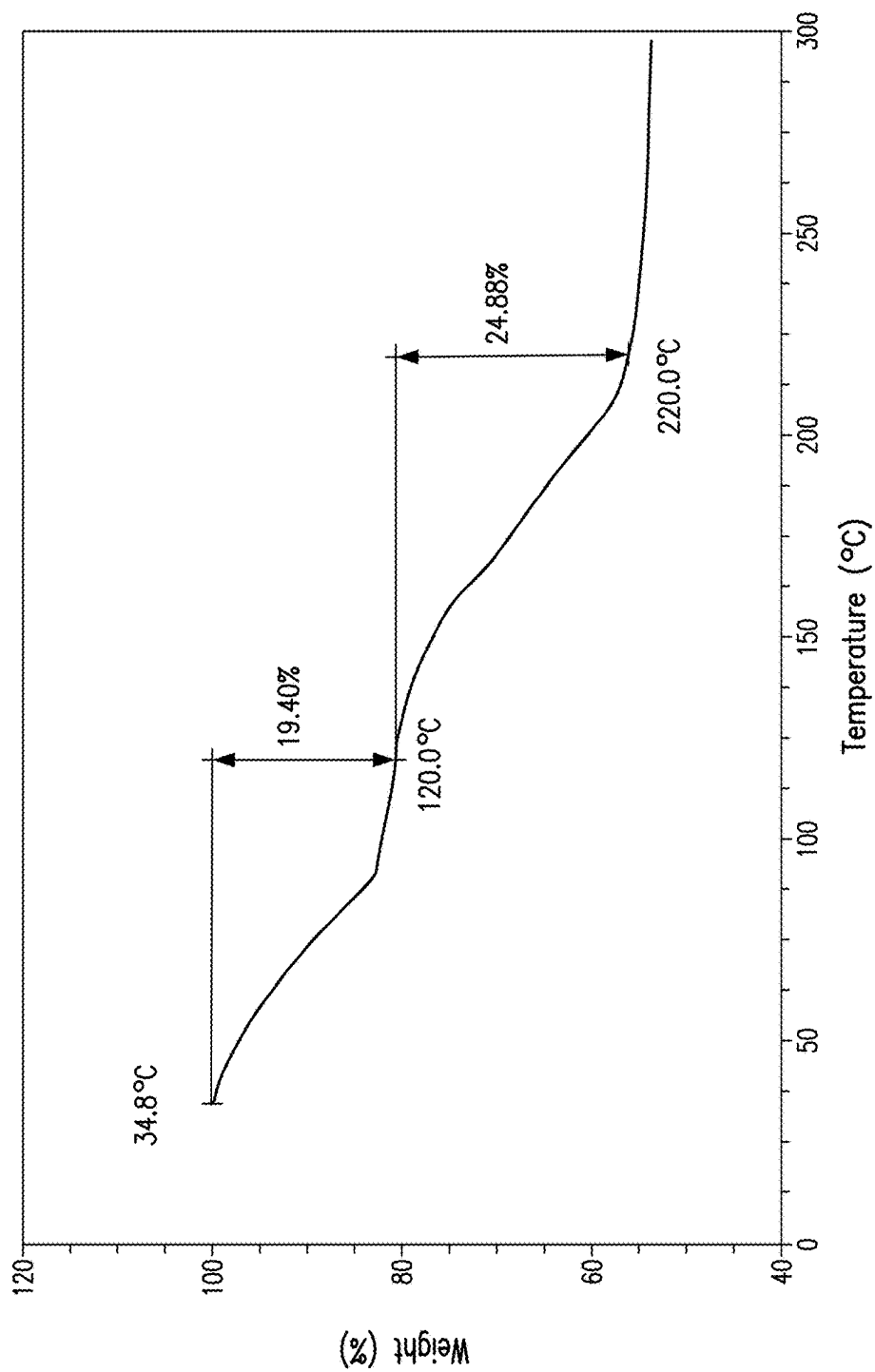
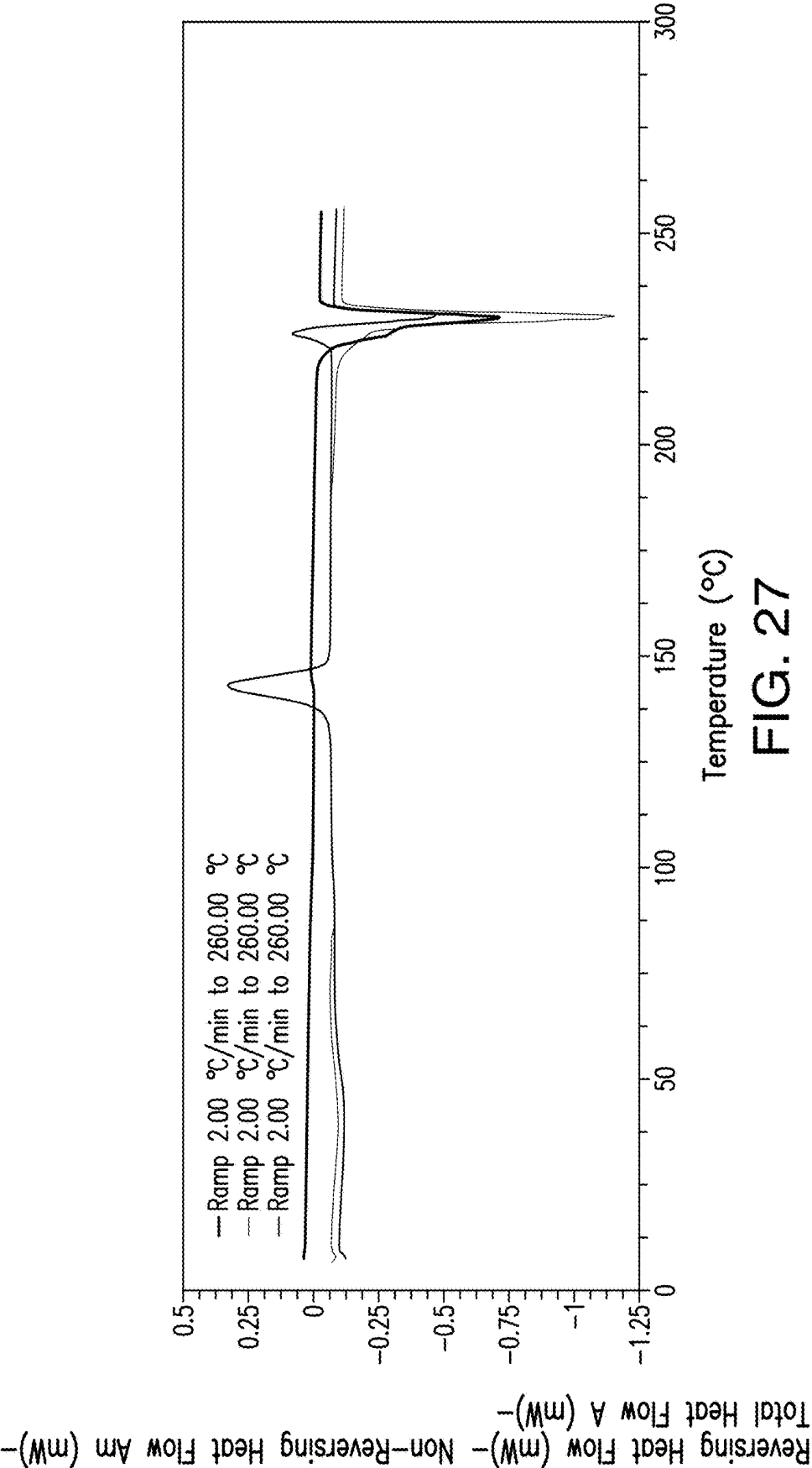


FIG. 26



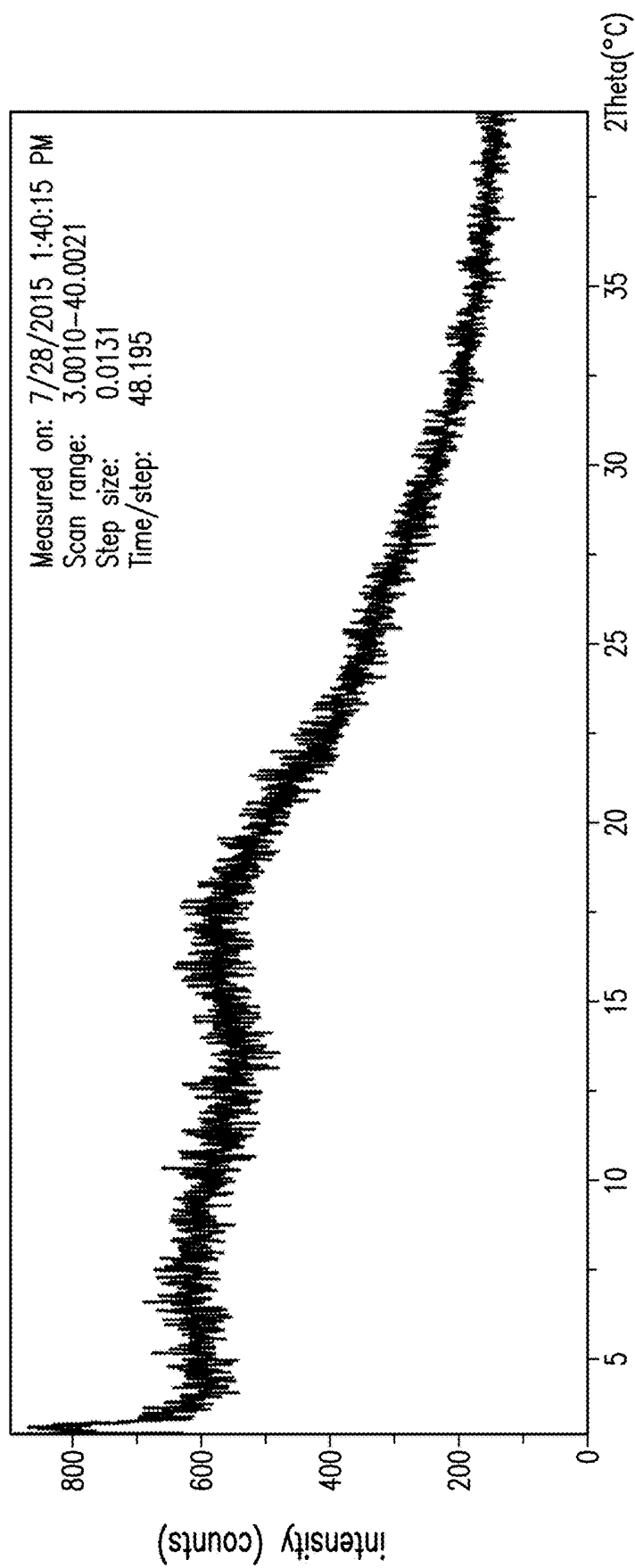
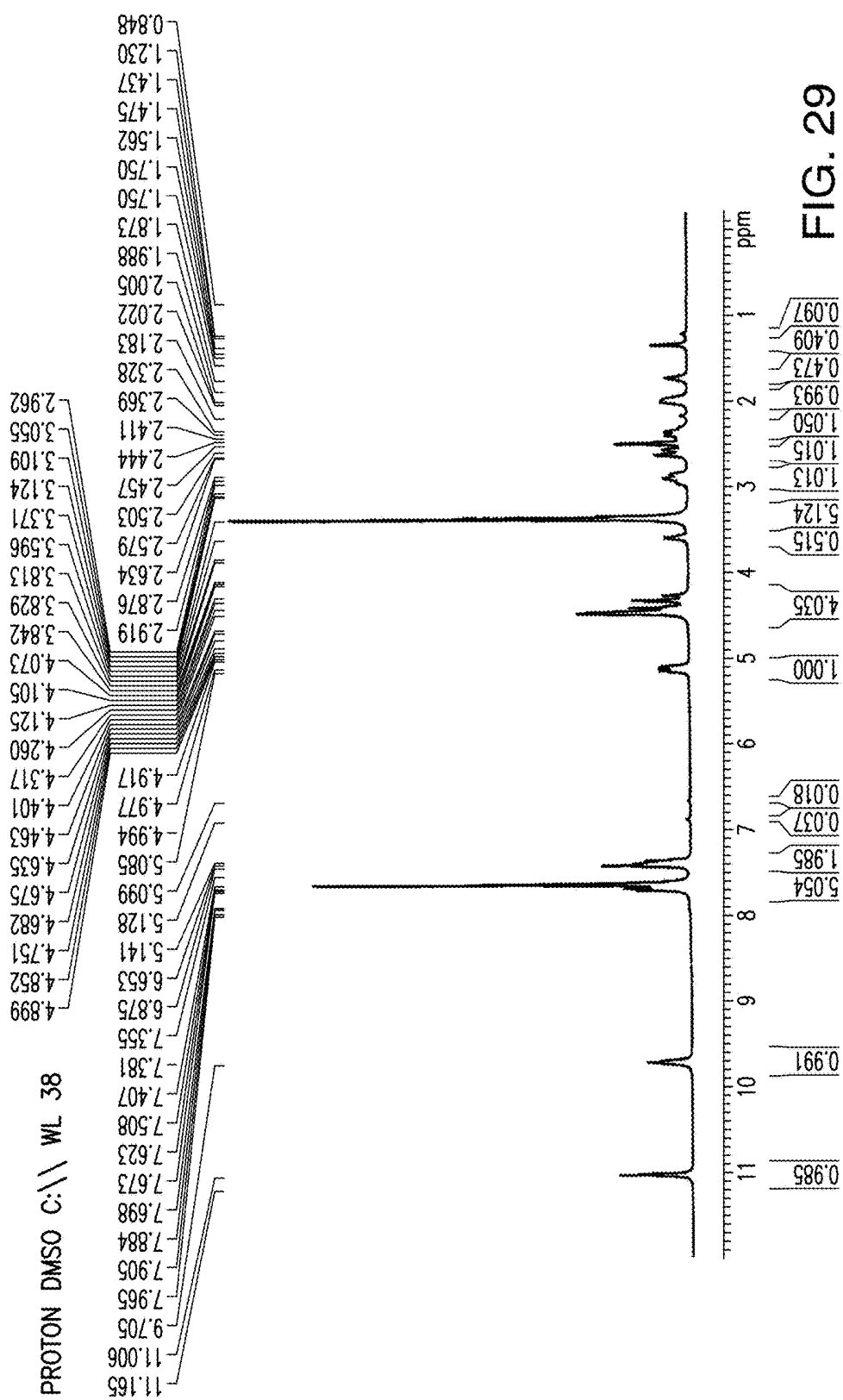
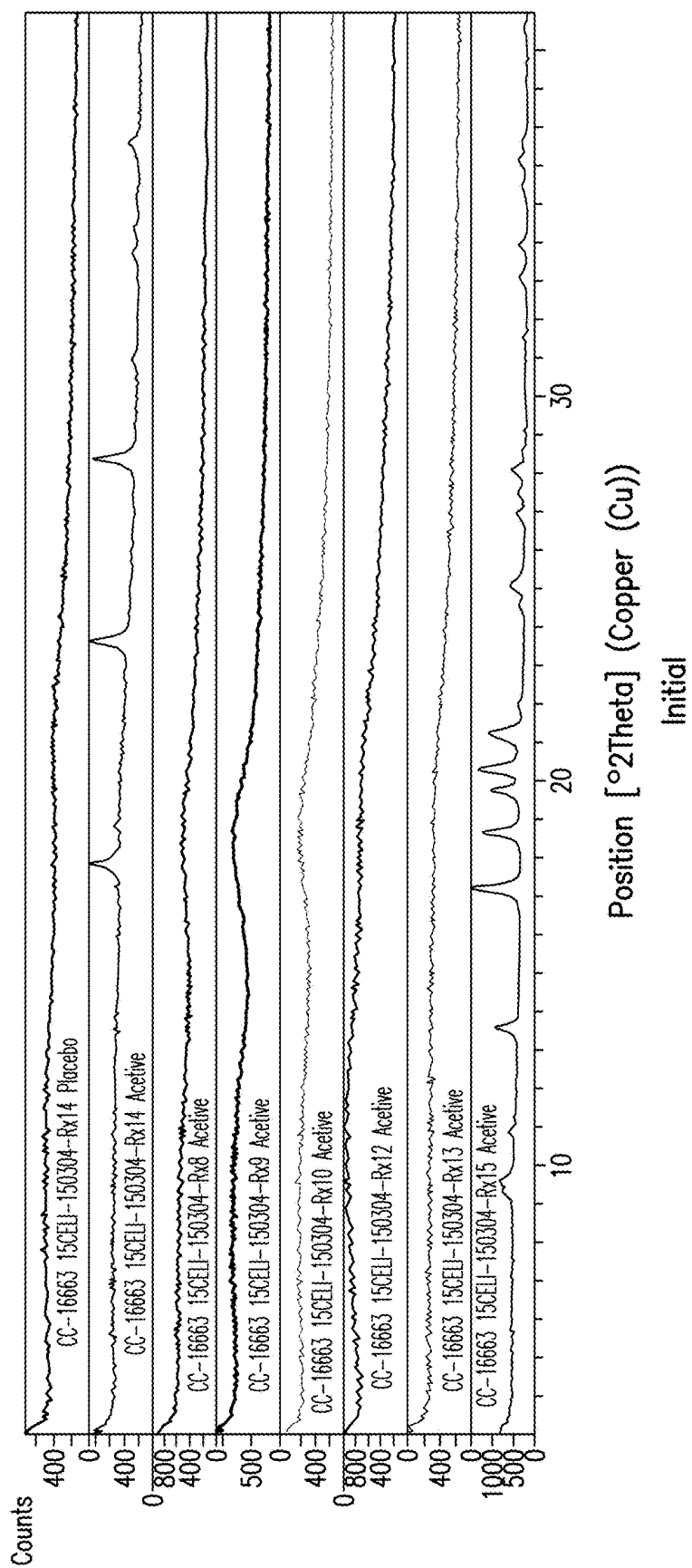
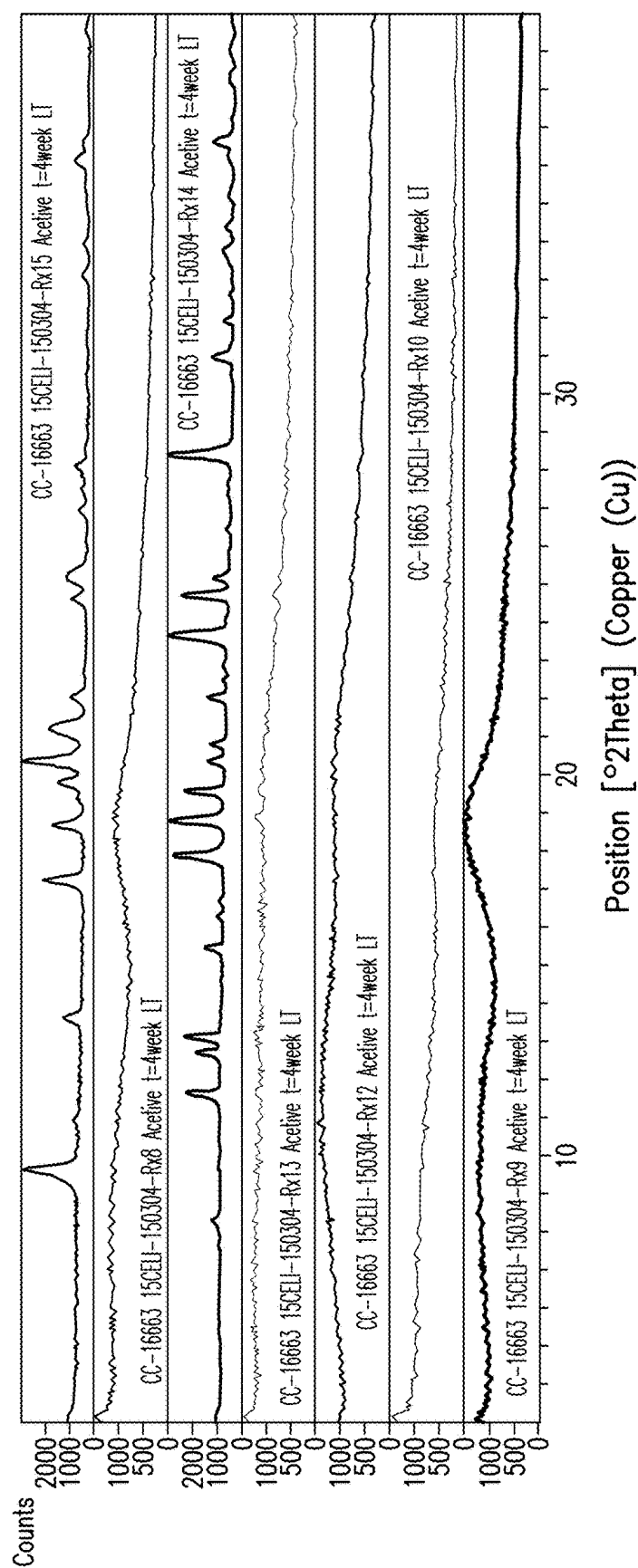


FIG. 28

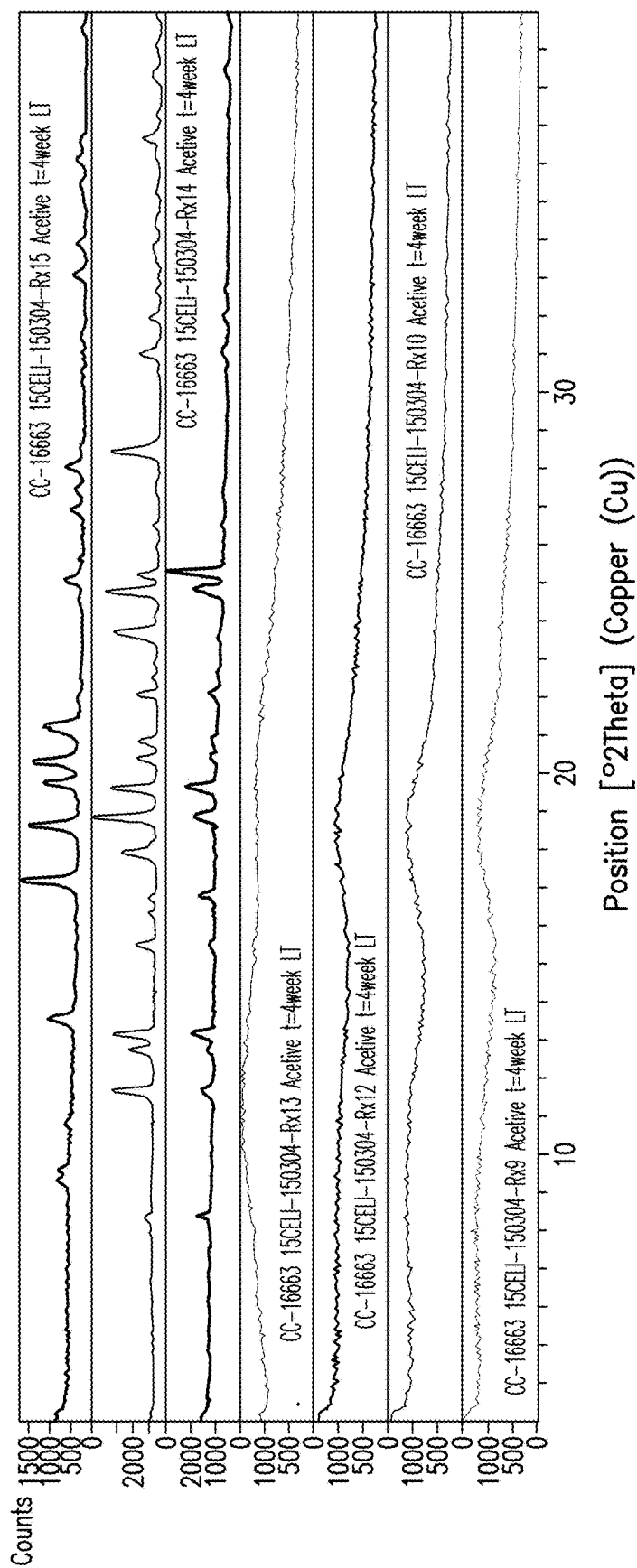






4-week stability samples at 25°C/60% RH

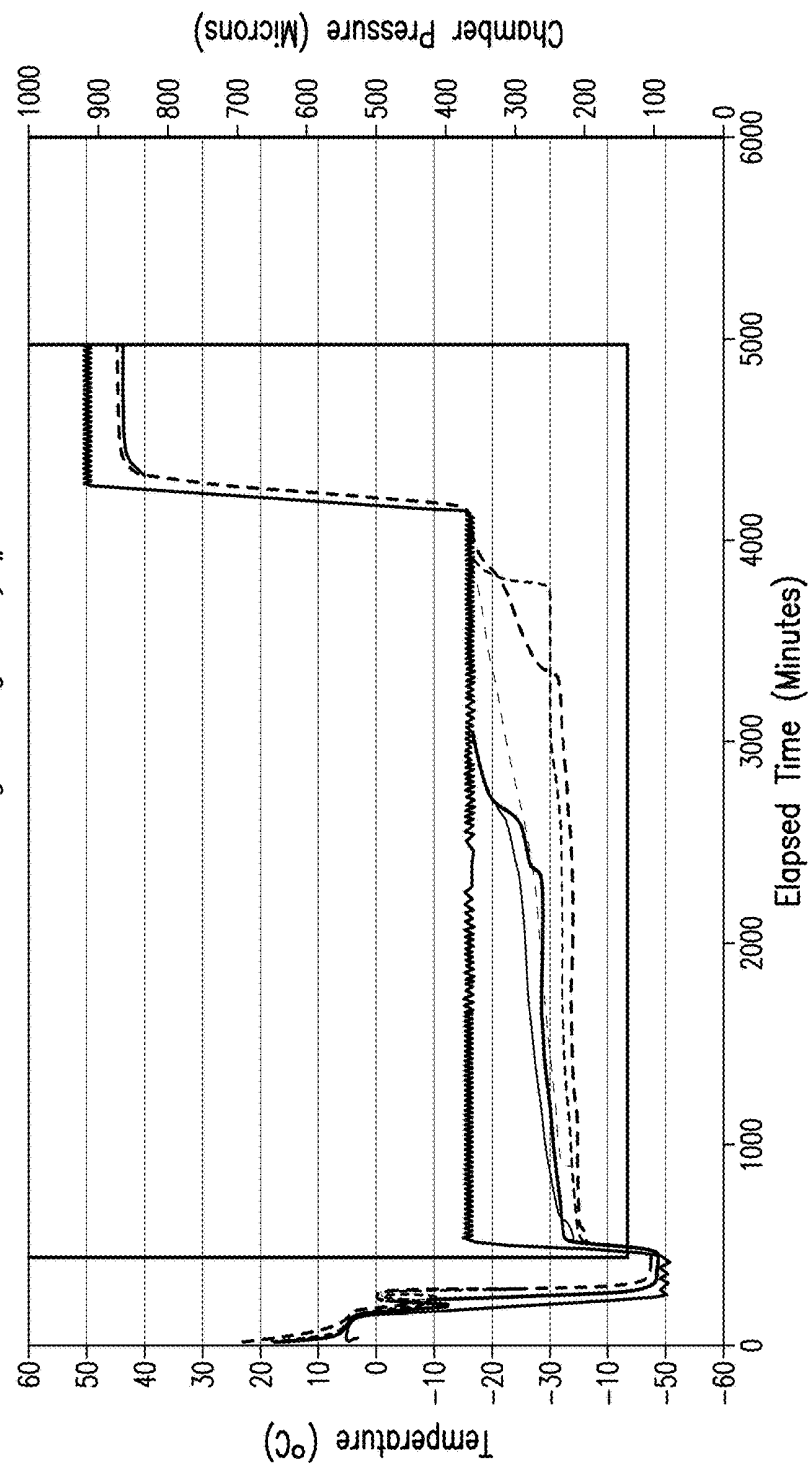
FIG. 30B



4-week stability samples at 40°C/75% RH

FIG. 30C

15CEL1: 150702
Process Engineering Study #5



--- T/C --- T/C --- B/C --- B/C --- Shelf In --- Chamber Pressure

FIG. 31

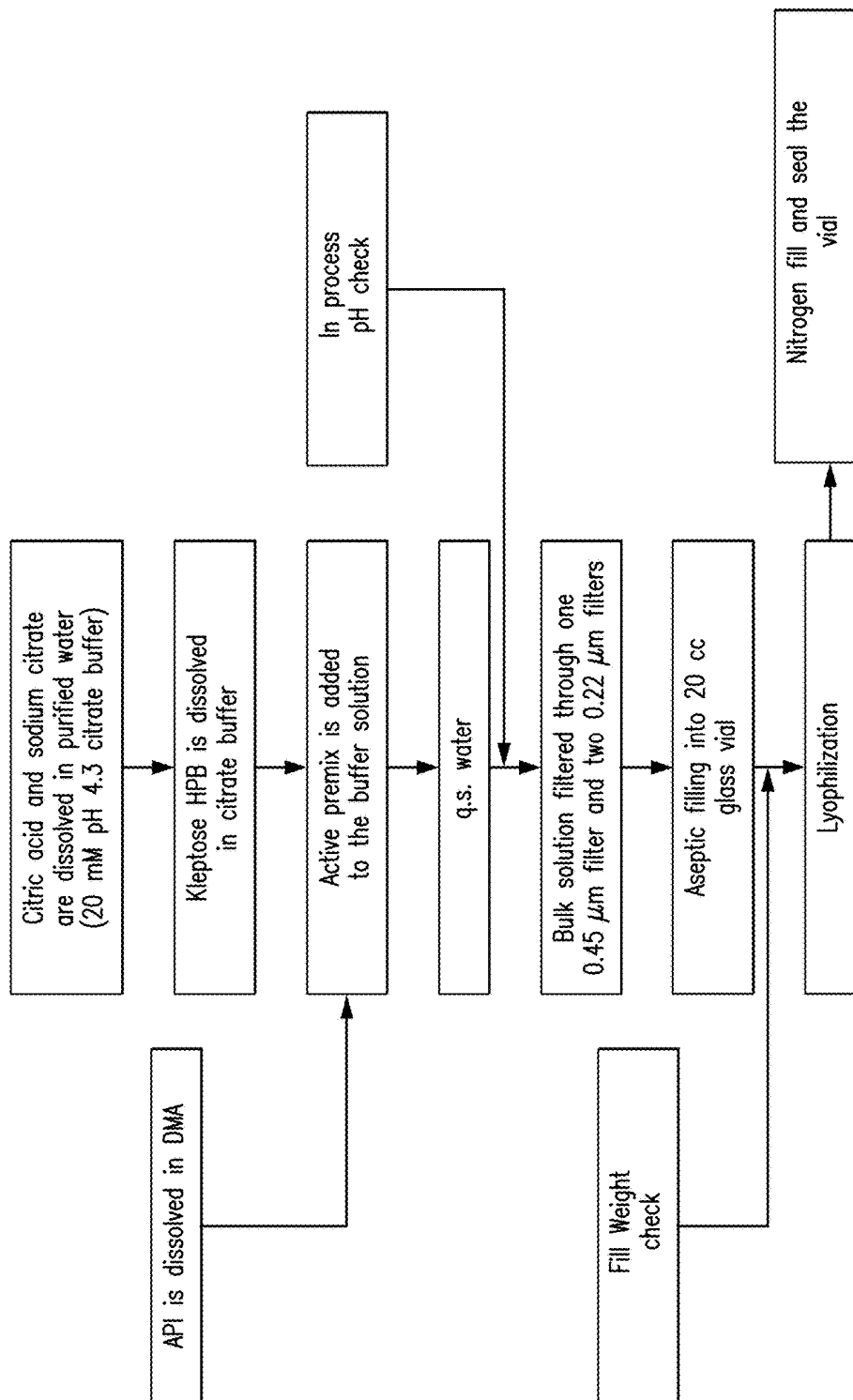


FIG. 32

1

**FORMULATIONS OF
2-(4-CHLOROPHENYL)-N-((2-(2,6-
DIOXIPERIDIN-3-YL)-1-OXISOINDOLIN-5-
YL)METHYL)-2,2-DIFLUOROACETAMIDE**

1. CROSS REFERENCE TO RELATED
APPLICATION

This application claims the benefit of the priority of U.S. Provisional Application No. 62/276,756, filed Jan. 8, 2016, the disclosure of which is incorporated herein by reference in its entirety

2. FIELD

Provided herein are formulations and dosage forms of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide or a stereoisomer or a mixture of stereoisomers, pharmaceutically acceptable salt, tautomer, prodrug, solvate, hydrate, co-crystal, clathrate, or polymorph thereof. Methods of using the formulations and dosage forms for treating, managing, and/or preventing cancer are also provided herein.

3. BACKGROUND

Drug substances are usually administered as part of a formulation in combination with one or more other agents that serve varied and specialized pharmaceutical functions. Dosage forms of various types may be made through selective use of pharmaceutical excipients. Pharmaceutical excipients have various functions and contribute to the pharmaceutical formulations in many different ways, e.g., solubilization, dilution, thickening, stabilization, preservation, coloring, flavoring, etc. The properties of pharmaceutical excipients that are considered when formulating an active drug substance include bioavailability, ease of manufacture, ease of administration, and stability of the dosage form. Due to the varying properties of the active drug substance to be formulated, and cross-reactivity between excipients, dosage forms typically require pharmaceutical excipients that are uniquely tailored to the active drug substance to achieve advantageous physical and pharmaceutical properties.

Nevertheless, use of pharmaceutical excipients in formulating dosage forms can, in some instances, cause undesirable adverse reactions with the active ingredient which manifest upon, for example, prolonged storage or contact with water. Indeed, it is well known that the properties of the final dosage form (e.g., its bioavailability and stability) are, for the most part, highly dependent on the excipients chosen, their concentration and interaction with both the active compound and each other. Excipients are more than inert or inactive ingredients and must be selected to avoid undesirable cross-reaction with active ingredients and other excipients in the formulation. Selecting compatible excipients is critical in formulating dosage forms to ensure the active ingredient is properly delivered and that the dosage form is a stable formulation.

2-(4-Chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide or a stereoisomer or mixture of stereoisomers, pharmaceutically acceptable salt, tautomer, prodrug, solvate, hydrate, co-crystal, clathrate, or polymorph thereof has been shown to have anticancer activities. There is a need for formulations of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide or a ste-

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reoisomer or mixture of stereoisomers, pharmaceutically acceptable salt, tautomer, prodrug, solvate, hydrate, co-crystal, clathrate, or polymorph thereof for treatment of cancer.

4. BRIEF SUMMARY

Provided herein are lyophilized formulations comprising 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide, or a stereoisomer or mixture of stereoisomers, pharmaceutically acceptable salt, tautomer, prodrug, solvate, hydrate, co-crystal, clathrate, or polymorph thereof ("Compound 1") and a pharmaceutically acceptable excipient. Compound 1 is described in U.S. Pat. No. 9,499,514 and International Publication No. WO 2016/007848, the disclosures of each which are incorporated herein by reference in their entireties. In one embodiment, Compound 1 is polymorph Form A, Form B, Form C, Form D, Form E or an amorphous form of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide. In one embodiment, Compound 1 is polymorph Form C of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide. The polymorphs of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide are described herein and in U.S. provisional patent application No. 62/276,750 filed on Jan. 8, 2016, entitled SOLID FORMS OF 2-(4-CHLOROPHENYL)-N-((2-(2,6-DIOXOPIPERIDIN-3-YL)-1-OXISOINDOLIN-5-YL)METHYL)-2,2-DIFLUOROACETAMIDE, AND THEIR PHARMACEUTICAL COMPOSITIONS AND USES", the disclosure of which is incorporated herein by reference in its entirety.

In certain embodiments, the lyophilized formulations provided herein comprise a solid form of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide. In certain embodiments, the lyophilized formulations provided herein comprise an amorphous form of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide.

In one aspect, the lyophilized formulations provided herein are suitable for reconstitution with a suitable diluent to the appropriate concentration prior to administration. In one embodiment, the lyophilized formulation is stable at room temperature. In one embodiment, the lyophilized formulation is stable at room temperature for up to about 24 months. In one embodiment, the lyophilized formulation is stable at room temperature for up to about 24 months, up to about 18 months, up to about 12 months, up to about 6 months, up to about 3 months or up to about 1 month. In one embodiment, the lyophilized formulation is stable upon storage under accelerated condition of 40° C./75% RH for up to about 12 months, up to about 6 months or up to about 3 months.

In one aspect, the lyophilized formulation provided herein is suitable for reconstitution with an aqueous solution for intravenous administrations. In one aspect, the lyophilized formulation provided herein is suitable for reconstitution with water. In one embodiment, the reconstituted aqueous solution is stable at room temperature for up to about 24 hours upon reconstitution. In one embodiment, the reconstituted aqueous solution is stable at room temperature from about 1-24, 2-20, 2-15, 2-10 hours upon reconstitution. In one embodiment, the reconstituted aqueous solution is stable at room temperature for up to about 20, 15, 12, 10, 8, 6, 4

or 2 hours upon reconstitution. In certain embodiments, the lyophilized formulations upon reconstitution have a pH of about 4 to 5.

In certain embodiment, the lyophilized formulations provided herein comprise Compound 1, a pH adjusting agent and a bulking agent.

In one embodiment, the lyophilized formulation provided herein comprises about 0.1-2% Compound 1, about 1-15% buffer and about 70-95% bulking agent based on the total weight of the lyophilized formulation.

In another aspect provided herein is a lyophilized formulation comprising Compound 1 in about 0.1 to about 2% based on the total weight of the lyophilized formulation. In still another aspect, provided herein is a lyophilized formulation that comprises Compound 1 in an amount of about 0.1 mg to about 5 mg in a vial, for example, a 20 cc vial.

In one aspect, the formulations provided herein comprise a citrate buffer in an amount from about 5% to about 25% based on total weight of the lyophilized formulation. In one embodiment, the citrate buffer comprises anhydrous citric acid and anhydrous sodium citrate.

In one aspect, the bulking agent in the formulations provided herein comprises Captisol®, mannitol or Kleptose®, for example, β -cyclodextrin, hydroxypropyl β -cyclodextrin and methylated β -cyclodextrin.

In certain embodiments, provided herein is a unit dosage form comprising a lyophilized formulation, wherein the lyophilized formulation comprises Compound 1, a buffer and a bulking agent.

In certain embodiments, provided herein is a container comprising a lyophilized formulation provided herein. In one aspect, the container is a glass vial.

In certain embodiments, provided herein are methods of treating, preventing or ameliorating cancer, including solid tumors and blood borne tumors, or one or more symptoms or causes thereof. In certain embodiments, provided herein are methods of preventing cancer, including solid tumors and blood borne tumors, or one or more symptoms or causes thereof. In certain embodiments, provided herein are methods of ameliorating cancer, including solid tumors and blood borne tumors, or one or more symptoms or causes thereof. In certain embodiments, the blood borne tumor is leukemia. In certain embodiments, methods provided herein encompass methods of treating various forms of leukemias such as chronic lymphocytic leukemia, chronic myeloid leukemia, acute lymphocytic leukemia, acute myeloid leukemia and acute myeloblastic leukemia. In certain embodiments, methods provided herein encompass methods of preventing various forms of leukemias such as chronic lymphocytic leukemia, chronic myeloid leukemia, acute lymphocytic leukemia, acute myeloid leukemia and acute myeloblastic leukemia. In certain embodiments, methods provided herein encompass methods of managing various forms of leukemias such as chronic lymphocytic leukemia, chronic myeloid leukemia, acute lymphocytic leukemia, acute myeloid leukemia and acute myeloblastic leukemia. The methods provided herein include treatment of leukemias that are relapsed, refractory or resistant. The methods provided herein include prevention of leukemias that are relapsed, refractory or resistant. The methods provided herein include management of leukemias that are relapsed, refractory or resistant. In one embodiment, methods provided herein encompass methods of treating acute myeloid leukemia. In one embodiment, methods provided herein encompass methods of preventing acute myeloid leukemia. In one embodiment, methods provided herein encompass methods of managing acute myeloid leukemia. In one embodiment,

methods provided herein encompass methods of treating a myelodysplastic syndrome. In one embodiment, methods provided herein encompass methods of preventing a myelodysplastic syndrome. In one embodiment, methods provided herein encompass methods of managing a myelodysplastic syndrome.

In one embodiment, provided herein are methods of treating acute myeloid leukemia by intravenous administration of a formulation comprising Compound 1. In one embodiment, provided herein are methods of treating a myelodysplastic syndrome by intravenous administration of a formulation comprising Compound 1.

In practicing the methods, compositions containing therapeutically effective concentrations of Compound 1 are administered to an individual exhibiting the symptoms of the disease or disorder to be treated. The amounts are effective to ameliorate or eliminate one or more symptoms of the disease or disorder.

Further provided is a pharmaceutical pack or kit comprising one or more containers filled with one or more of the ingredients of the pharmaceutical compositions. Optionally associated with such container(s) can be a notice in the form prescribed by a governmental agency regulating the manufacture, use or sale of pharmaceuticals or biological products, which notice reflects approval by the agency of manufacture, use of sale for human administration. The pack or kit can be labeled with information regarding mode of administration, sequence of drug administration (e.g., separately, sequentially or concurrently), or the like.

These and other aspects of the subject matter described herein will become evident upon reference to the following detailed description.

5. BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 depicts an X-ray powder diffractogram stack plot of Forms A, B, C, D, and E of Compound 1.

FIG. 2 depicts an X-ray powder diffractogram (XRPD) plot of Form A of Compound 1.

FIG. 3 depicts a SEM image of Form A of Compound 1.

FIG. 4 depicts a thermogravimetric analysis (TGA) plot of Form A of Compound 1.

FIG. 5 depicts a differential scanning calorimetry (DSC) thermogram plot of Form A of Compound 1.

FIG. 6 provides a dynamic vapor sorption (DVS) isotherm plot of Form A of Compound 1.

FIG. 7 provides a ^1H NMR spectrum of Form A of Compound 1.

FIG. 8 depicts the comparison of the X-ray powder diffractogram plots of Form A of Compound 1 before (a) and after (b) compression.

FIG. 9 depicts an XRPD plot of Form B of Compound 1.

FIG. 10 depicts a SEM image of Form B of Compound 1.

FIG. 11 depicts a TGA thermogram plot of Form B of Compound 1.

FIG. 12 depicts a DSC thermogram plot of Form B of Compound 1.

FIG. 13 provides a DVS isotherm plot of Form B of Compound 1.

FIG. 14 provides a ^1H NMR spectrum of Form B of Compound 1.

FIG. 15 depicts the comparison of the X-ray powder diffractogram plots of Form B of Compound 1 before (a) and after (b) compression.

FIG. 16 depicts an XRPD plot of Form C of Compound 1.

FIG. 17 depicts a SEM image of Form C of Compound 1.

FIG. 18 depicts a TGA thermogram plot of Form C of Compound 1.

FIG. 19 depicts a DSC thermogram of Form C of Compound 1.

FIG. 20 provides a DVS isotherm plot of Form C of Compound 1.

FIG. 21 provides a ¹H NMR spectrum of Form C of Compound 1.

FIG. 22 depicts the comparison of the X-ray powder diffractogram plots of Form C of Compound 1 before (a) and after (b) compression.

FIG. 23 depicts an XRPD plot of Form D of Compound 1.

FIG. 24 depicts a TGA thermogram plot of Form D of Compound 1.

FIG. 25 depicts an XRPD plot of Form E of Compound 1.

FIG. 26 depicts a TGA thermogram plot of Form E of Compound 1.

FIG. 27 depicts the modulated DSC thermogramplot of amorphous Compound 1.

FIG. 28 depicts an XRPD plot of amorphous Compound 1.

FIG. 29 depicts a ¹H NMR spectrum of amorphous Compound 1.

FIGS. 30A, 30 B and 30C. Illustrate XRPD profiles of the lyophilized formulations in the second screen.

FIG. 31. Illustrates temperature profile of the final lyophilization process.

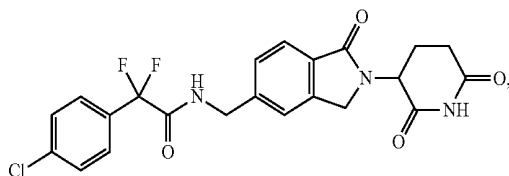
FIG. 32. Illustrates a process diagram of Compound 1 formulation.

6. DETAILED DESCRIPTION

6.1 Definitions

Generally, the nomenclature used herein and the laboratory procedures in organic chemistry, medicinal chemistry, and pharmacology described herein are those well known and commonly employed in the art. Unless defined otherwise, all technical and scientific terms used herein generally have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure belongs.

The term Compound 1 refers to "2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide" having the structure:



and its stereoisomers or mixture of stereoisomers, pharmaceutically acceptable salts, tautomers, prodrugs, solvates, hydrates, co-crystals, clathrates, or polymorphs thereof. In certain embodiments, Compound 1 refers to 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide and its tautomers. In certain embodiments, Compound 1 refers to a polymorph of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide. In certain embodiments, Compound 1 refers to polymorph Form C of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-ox-

oisindolin-5-yl)methyl)-2,2-difluoroacetamide. In one embodiment, the stereoisomer is an enantiomer.

As used herein, and unless otherwise specified, the term "lyophilize" refers to the process of isolating a solid substance from solution and/or removal of solvent. In some embodiments, this may be achieved by various techniques known to one of skill in the art, including, for example, evaporation (e.g., under vacuum, for example by freeze drying, and/or freezing the solution and vaporizing the frozen solvent under vacuum or reduced pressure conditions, etc.). In some embodiments, the solution contains a cosolvent.

As used herein, the term "cosolvent" refers to a solvent that aids the solubilization of an active agent in water during the manufacturing of a lyophilized formulation provided herein. The cosolvent can be a solvent that also provides sufficient stability of the intermediate formulation during manufacture. The cosolvent can also be removed from the lyophilized formulation, or reduced to an acceptable level, during manufacture. Examples of cosolvents include acetonitrile, chloroform, tert-butanol, dimethylacetamide, methanol, tetrahydrofuran, acetic acid, acetone, anisole, butanol, butyl acetate, tert-butylmethyl ether, ethanol, ethyl acetate, ethyl ether, ethyl formate, heptanes, isobutyl acetate, isopropyl acetate, methyl acetate, 3-methyl-butanol, methyl-ethyl ketone, methylisobutyl ketone, 2-methyl-1-propanol, pentane, 1-pentanol, 1-propanol, 2-propanol, and propyl acetate.

As used herein, and unless otherwise specified, the term "parenteral" includes subcutaneous, intravenous, intramuscular, intra-articular, intra-synovial, intrasternal, intrathecal, intrahepatic, intralesional and intracranial injection or infusion techniques.

As used herein, and unless otherwise specified, the term "substantially free of" means containing no more than an insignificant amount. In some embodiments, a composition or preparation is "substantially free of" a recited element if it contains less than 5%, 4%, 3%, 2%, or 1%, by weight of the element. In some embodiments, the composition or preparation contains less than 0.9%, 0.8%, 0.7%, 0.6%, 0.5%, 0.4%, 0.3%, 0.2%, 0.1% or less of the recited element. In some embodiments, the composition or preparation contains an undetectable amount of the recited element.

As used herein, "reconstituted aqueous solution" or "reconstituted aqueous composition" or "reconstituted aqueous formulation" refers to an aqueous solution obtained by dissolving a lyophilized composition provided herein in an aqueous solvent.

The term "aqueous diluent" used herein refers to an aqueous liquid capable of being included in a parenteral formulation. Such aqueous diluents can include, for example, saline or dextrose if desired, as well as any of the known ancillary preservatives or excipients commonly found as part of parenteral formulations. Exemplary aqueous diluents include water, 5% dextrose solution, and the like.

As used herein, and unless otherwise specified, the expression "unit dose" refers to a physically discrete unit of a formulation appropriate for a subject to be treated (e.g., for a single dose); each unit containing a predetermined quantity of an active agent selected to produce a desired therapeutic effect (it being understood that multiple doses may be required to achieve a desired or optimum effect), optionally together with a pharmaceutically acceptable carrier, which may be provided in a predetermined amount. The unit dose may be, for example, a volume of liquid (e.g., an acceptable carrier) containing a predetermined quantity of one or more therapeutic agents, a predetermined amount of one or more

therapeutic agents in solid form, a sustained release formulation or drug delivery device containing a predetermined amount of one or more therapeutic agents, etc. It will be appreciated that a unit dose may contain a variety of components in addition to the therapeutic agent(s). For example, acceptable carriers (e.g., pharmaceutically acceptable carriers), diluents, stabilizers, buffers, preservatives, etc., may be included as described infra. It will be understood, however, that the total daily usage of a formulation of the present disclosure will be decided by the attending physician within the scope of sound medical judgment. The specific effective dose level for any particular subject or organism may depend upon a variety of factors including the disorder being treated and the severity of the disorder; activity of specific active compound employed; specific composition employed; age, body weight, general health, sex and diet of the subject; time of administration, and rate of excretion of the specific active compound employed; duration of the treatment; drugs and/or additional therapies used in combination or coincidental with specific compound(s) employed, and like factors well known in the medical arts.

As used herein, the term “solid form” refers a crystal form or an amorphous form or a mixture thereof of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide or a stereoisomer or mixture of stereoisomers, pharmaceutically acceptable salt, tautomer, prodrug, solvate, hydrate, co-crystal, clathrate, or polymorph thereof.

As used herein, unless otherwise specified, the term “pharmaceutically acceptable salt(s),” as used herein includes, but is not limited to, salts of acidic or basic moieties of compounds described herein (e.g., Compound 1). Basic moieties are capable of forming a wide variety of salts with various inorganic and organic acids. The acids that can be used to prepare pharmaceutically acceptable acid addition salts of such basic compounds are those that form non-toxic acid addition salts, e.g., salts containing pharmacologically acceptable anions. Suitable organic acids include, but are not limited to, maleic, fumaric, benzoic, ascorbic, succinic, acetic, formic, oxalic, propionic, tartaric, salicylic, citric, gluconic, lactic, mandelic, cinnamic, oleic, tannic, aspartic, stearic, palmitic, glycolic, glutamic, gluconic, glucaronic, saccharic, isonicotinic, methanesulfonic, ethanesulfonic, p-toluenesulfonic, benzenesulfonic acids, or pamoic (e.g., 1,1'-methylene-bis-(2-hydroxy-3-naphthoate) acids. Suitable inorganic acids include, but are not limited to, hydrochloric, hydrobromic, hydroiodic, sulfuric, phosphoric, or nitric acids. Compounds that include an amine moiety can form pharmaceutically acceptable salts with various amino acids, in addition to the acids mentioned above. Chemical moieties that are acidic in nature are capable of forming base salts with various pharmacologically acceptable cations. Examples of such salts are alkali metal or alkaline earth metal salts and, particularly, calcium, magnesium, sodium, lithium, zinc, potassium, or iron salts.

As used herein, and unless otherwise specified, the term “solvate” means a compound provided herein or a salt thereof that further includes a stoichiometric or non-stoichiometric amount of solvent bound by non-covalent intermolecular forces. Where the solvent is water, the solvate is a hydrate.

As used herein and unless otherwise indicated, the term “prodrug” means a derivative of a compound that can hydrolyze, oxidize, or otherwise react under biological conditions (in-vitro or in-vivo) to provide the compound. Examples of prodrugs include, but are not limited to, deriva-

tives of compounds described herein (e.g., Compound 1) that include biohydrolyzable moieties such as biohydrolyzable amides, biohydrolyzable esters, biohydrolyzable carbamates, biohydrolyzable carbonates, biohydrolyzable ureides, and biohydrolyzable phosphate analogues. Other examples of prodrugs include derivatives of compounds described herein (e.g., Compound 1) that include NO, NO₂, ONO, or ONO₂ moieties.

A “pharmaceutically acceptable excipient,” refers to a substance that aids the administration of an active agent to a subject by for example modifying the stability of an active agent or modifying the absorption by a subject upon administration. A pharmaceutically acceptable excipient typically has no significant adverse toxicological effect on the patient. Examples of pharmaceutically acceptable excipients include, for example, water, NaCl (including salt solutions), normal saline solutions, sucrose, glucose, bulking agents, buffers, binders, fillers, disintegrants, lubricants, coatings, sweeteners, flavors, alcohols, oils, gelatins, carbohydrates such as amylose or starch, fatty acid esters, hydroxymethylcellulose, polyvinyl pyrrolidone, and colors, and the like. One of skill in the art will recognize that other pharmaceutical excipients known in the art are useful in the present invention and include those listed in for example the *Handbook of Pharmaceutical Excipients*, Rowe R. C., Shesky P. J., and Quinn M. E., 6th Ed., The Pharmaceutical Press, RPS Publishing (2009). The terms “bulking agent”, and “buffer” are used in accordance with the plain and ordinary meaning within the art.

As used herein, “administer” or “administration” refers to the act of physically delivering a substance as it exists outside the body into a subject. Administration includes all forms known in the art for delivering therapeutic agents, including but not limited to topical, mucosal, injections, intradermal, intravenous, intramuscular delivery or other method of physical delivery described herein or known in the art (e.g., implantation of a slow-release device, such as a mini-osmotic pump to a subject; liposomal formulations; buccal; sublingual; palatal; gingival; nasal; vaginal; rectal; intra-arteriole; intraperitoneal; intraventricular; intracranial; or transdermal).

“Anti-cancer agents” refer to anti-metabolites (e.g., 5-fluoro-uracil, methotrexate, fludarabine), antimicrotubule agents (e.g., vinca alkaloids such as vincristine, vinblastine; taxanes such as paclitaxel, docetaxel), alkylating agents (e.g., cyclophosphamide, melphalan, carmustine, nitrosoureas such as bischloroethylnitrosourea and hydroxyurea), platinum agents (e.g. cisplatin, carboplatin, oxaliplatin, JM-216 or satraplatin, CI-973), anthracyclines (e.g., doxorubicin, daunorubicin), antitumor antibiotics (e.g., mitomycin, idarubicin, adriamycin, daunomycin), topoisomerase inhibitors (e.g., etoposide, camptothecins), anti-angiogenesis agents (e.g. Sutent® and Bevacizumab) or any other cytotoxic agents, (estramustine phosphate, prednimustine), hormones or hormone agonists, antagonists, partial agonists or partial antagonists, kinase inhibitors, checkpoint inhibitors, and radiation treatment.

By “co-administer” it is meant that a composition described herein is administered at the same time, just prior to, or just after the administration of one or more additional therapeutic compositions, including for example an anti-cancer agent. Co-administration is meant to include simultaneous or sequential administration of compounds individually or in combination (more than one compound or agent). Co-administration includes administering two active agents simultaneously, approximately simultaneously (e.g., within about 1, 5, 10, 15, 20, or 30 minutes of each other),

or sequentially in any order. Thus, co-administration can include administering one active agent (e.g. a compound described herein) within 0.5, 1, 2, 4, 6, 8, 10, 12, 16, 20, or 24 hours of a second active agent. Co-administration can also be accomplished by co-formulation, e.g., preparing a single dosage form including both active agents. The active agents can be formulated separately. In such instances, the active agents are admixed and included together in the final form of the dosage unit. Alternatively, co-administration as described herein can include administering two separate unit dosage forms of at least two separate active agents (e.g., Compound 1 and a second active agent described herein).

As used herein, the term “daily” is intended to mean that a therapeutic compound, such as Compound 1, is administered once or more than once each day for a period of time. The term “continuous” is intended to mean that a therapeutic compound, such as Compound 1, is administered daily for an uninterrupted period of at least 10 days to 52 weeks. The term “intermittent” or “intermittently” as used herein is intended to mean stopping and starting at either regular or irregular intervals. For example, intermittent administration of Compound 1 is administration for one to six days per week, administration in cycles (e.g., daily administration for one to ten consecutive days of a 28 day cycle, then a rest period with no administration for rest of the 28 day cycle or daily administration for two to eight consecutive weeks, then a rest period with no administration for up to one week), or administration on alternate days. The term “cycling” as used herein is intended to mean that a therapeutic compound, such as Compound 1, is administered daily or continuously but with a rest period.

An “effective amount” is an amount sufficient to achieve the effect for which it is administered (e.g., treat a disease or reduce one or more symptoms of a disease or condition). Thus, administration of an “amount” of a compound described herein to a subject refers to administration of “an amount effective,” to achieve the desired therapeutic result. A “therapeutically effective amount” of a compound described herein for purposes herein is thus determined by such considerations as are known in the art. The term “therapeutically effective amount” of a composition described herein refers to the amount of the composition that, when administered, is sufficient to treat one or more of the symptoms of a disease described herein (e.g., AML). Administration of a compound described herein can be determined according to factors such as, for example, the disease state, age, sex, and weight of the individual. A therapeutically effective amount also refers to any toxic or detrimental effects of Compound 1 are outweighed by the therapeutically beneficial effects.

As used herein the terms “treat,” “treating” and “treatment” contemplate an action that occurs while a subject is suspected, diagnosed or suffering from a disease described herein (e.g., leukemia, including AML or MDS), which reduces the severity or symptoms of the disease, or retards or slows the progression or symptoms of the disease.

The terms “subject,” “patient,” “subject in need thereof,” and “patient in need thereof” are herein used interchangeably and refer to a living organism suffering from one or more of the diseases described herein (e.g., AML or MDS) that can be treated by administration of a composition described herein. Non-limiting examples of organisms include humans, other mammals, bovines, rats, mice, dogs, monkeys, goat, sheep, cows, deer, and other non-mammalian animals. In embodiments, a subject is human. A human subject can be between the ages of about 1 year old to about 100 years old. In embodiments, subjects herein can be

characterized by the disease being treated (e.g., a “AML subject”, a “cancer subject”, an “MDS subject” or a “leukemia subject”).

As used herein, and unless otherwise specified, the terms “prevent,” “preventing” and “prevention” refer to the prevention of the onset, recurrence or spread of a disease or disorder, or of one or more symptoms thereof. The terms “prevent,” “preventing” and “prevention” contemplate an action that occurs before a patient begins to suffer from the specified disease or disorder or symptoms thereof, which inhibits or reduces the severity of the disease or disorder.

As used herein, and unless otherwise indicated, the terms “manage,” “managing” and “management” encompass preventing the recurrence of the specified disease or disorder in a patient who has already suffered from the disease or disorder, or lengthening the time that a patient who has suffered from the disease or disorder remains in remission. The terms encompass modulating the threshold, development or duration of the disease or disorder, or changing the way that a patient responds to the disease or disorder.

As used herein, and unless otherwise specified, the term “about,” when used in connection with doses, amounts, or weight percent of ingredients of a composition or a dosage form, means dose, amount, or weight percent that is recognized by those of ordinary skill in the art to provide a pharmacological effect equivalent to that obtained from the specified dose, amount, or weight percent is encompassed. Specifically, the term “about” contemplates a dose, amount, or weight percent within 30%, 25%, 20%, 15%, 10%, or 5% of the specified dose, amount, or weight percent is encompassed.

As used herein, and unless otherwise specified, the term “stable,” when used in connection with a formulation or a dosage form, means that the active ingredient of the formulation or dosage form remains solubilized for a specified amount of time and does not significantly degrade or aggregate or become otherwise modified (e.g., as determined, for example, by HPLC). In some embodiments, about 70% or greater, about 80% or greater or about 90% or greater of the compound remains solubilized after the specified period. Stability can also refer to the compatibility of pharmaceutically acceptable excipients described herein. Accordingly, a dosage form can be considered stable when the combined pharmaceutically acceptable excipients and active agent(s) described herein do not degrade or otherwise modify (e.g., react with) the effectiveness or therapeutic value of an active agent described herein.

As used herein, the term “tumor,” refers to all neoplastic cell growth and proliferation, whether malignant or benign, and all pre-cancerous and cancerous cells and tissues. “Neoplastic,” as used herein, refers to any form of dysregulated or unregulated cell growth, whether malignant or benign, resulting in abnormal tissue growth. Thus, “neoplastic cells” include malignant and benign cells having dysregulated or unregulated cell growth.

As used herein, “hematologic malignancy” refers to cancer of the body’s blood-forming and immune system—the bone marrow and lymphatic tissue. Such cancers include leukemias, lymphomas (Non-Hodgkin’s Lymphoma), Hodgkin’s disease (also called Hodgkin’s Lymphoma), myelodysplastic syndrome (MDS), and myeloma. In one embodiment, the myeloma is multiple myeloma. In some embodiments, the leukemia is, for example, acute myelogenous leukemia (AML), acute lymphocytic leukemia (ALL), adult T-cell leukemia, chronic lymphocytic leukemia (CLL), hairy cell leukemia, myelodysplasia, myeloproliferative disorders, chronic myelogenous leukemia (CML), myelodys-

plastic syndrome (MDS), human lymphotropic virus-type 1 (HTLV 1) leukemia, mastocytosis, or B-cell acute lymphoblastic leukemia. In some embodiments, the lymphoma is, for example, diffuse large B-cell lymphoma (DLBCL), B-cell immunoblastic lymphoma, small non-cleaved cell lymphoma, human lymphotropic virus-type 1 (HTLV-1) leukemia/lymphoma, adult T-cell lymphoma, peripheral T-cell lymphoma (PTCL), cutaneous T-cell lymphoma (CTCL), mantle cell lymphoma (MCL), Hodgkin lymphoma (HL), non-Hodgkin lymphoma (NHL), AIDS-related lymphoma, follicular lymphoma, small lymphocytic lymphoma, T-cell/histiocyte rich large B-cell lymphoma, transformed lymphoma, primary mediastinal (thymic) large B-cell lymphoma, splenic marginal zone lymphoma, Richter's transformation, nodal marginal zone lymphoma, or ALK-positive large B-cell lymphoma. In one embodiment, the hematological cancer is indolent lymphoma including, for example, DLBCL, follicular lymphoma, or marginal zone lymphoma.

The term "leukemia" refers to malignant neoplasms of the blood-forming tissues. The leukemia includes, but is not limited to, chronic lymphocytic leukemia, chronic myelocytic leukemia, acute lymphoblastic leukemia, acute myeloid leukemia, and acute myeloblastic leukemia. The leukemia can be relapsed, refractory or resistant to conventional therapy.

The term "myelodysplastic syndrome" refers to hematological conditions characterized by abnormalities in the production of one or more of the cellular components of blood (red cells, white cells (other than lymphocytes) and platelets (or their progenitor cells, megakaryocytes)), and includes the following disorders: refractory anemia (RA); RA with ringed sideroblasts (RARS); RA with excess of blasts (RAEB); refractory cytopenia with multilineage dysplasia (RCMD); refractory cytopenia with unilineage dysplasia (RCUD); unclassifiable myelodysplastic syndrome (MDS-U), myelodysplastic syndrome associated with an isolated del(5q) chromosome abnormality, therapy-related myeloid neoplasms and chronic myelomonocytic leukemia (CMML).

As used herein, "promyelocytic leukemia" or "acute promyelocytic leukemia" refers to a malignancy of the bone marrow in which there is a deficiency of mature blood cells in the myeloid line of cells and an excess of immature cells called promyelocytes. It is usually marked by an exchange of regions of chromosomes 15 and 17.

As used herein, "acute lymphocytic leukemia (ALL)", also known as "acute lymphoblastic leukemia" refers to a malignant disease caused by the abnormal growth and development of early nongranular white blood cells, or lymphocytes.

As used herein, "T-cell leukemia" refers to a disease in which certain cells of the lymphoid system called T lymphocytes or T cells are malignant. T cells are white blood cells that normally can attack virus-infected cells, foreign cells, and cancer cells and produce substances that regulate the immune response.

The term "relapsed" refers to a situation where patients who have had a remission of cancer after therapy have a return of cancer cells in the marrow and/or a decrease in normal blood cells.

The term "refractory or resistant" refers to a circumstance where patients, even after intensive treatment, have residual cancer cells, for example in their marrow.

As used herein, overall survival (OS) means the time from randomization in a clinical trial until death from any cause. As used herein, progression-free survival (PFS) means the time from randomization in a clinical trial until progression

or death. As used herein, event-free survival (EFS) means the time from study entry until any treatment failure, including disease progression, treatment discontinuation for any reason, or death. As used herein, overall response rate (ORR) means the sum of the percentage of patients who achieve complete and partial responses. As used herein, duration of response (DoR) is the time from achieving a response until relapse or disease progression.

As used herein, the abbreviations for any protective groups, amino acids and other compounds, are, unless indicated otherwise, in accord with their common usage, recognized abbreviations, or the IUPAC-IUB Commission on Biochemical Nomenclature (see, *Biochem.* 1972, 11:942-944).

6.2 Polymorphs of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide

In one embodiment, Compound 1 is polymorph Form A, Form B, Form C, Form D, Form E or an amorphous form of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide. Polymorphs of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide are described in a U.S. provisional patent application filed concurrently herewith entitled SOLID FORMS OF 2-(4-CHLOROPHENYL)-N-((2-(2,6-DIOXOPIPERIDIN-3-YL)-1-OXOISINDOLIN-5-YL)METHYL)-2,2-DIFLUOROACETAMIDE, AND THEIR PHARMACEUTICAL COMPOSITIONS AND USES", the disclosure of which is incorporated herein by reference in its entirety. Polymorphs of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide are briefly described herein.

Form A of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide

In certain embodiments, the lyophilized formulations provided herein are prepared from Form A of Compound 1.

In one embodiment, Form A is an anhydrous form of Compound 1. In another embodiment, Form A of Compound 1 is crystalline.

In certain embodiments, Form A is obtained by crystallization from certain solvent systems, for example, solvent systems comprising one or more of the following solvents: acetone and the solvent mixture of isopropanol and water at room temperature. In certain embodiments, Form A is obtained as an intermediate solid form from slurries at elevated temperature, for example about 50° C., in ethanol/water (1:1), acetone or acetonitrile.

In certain embodiments, Form A is substantially crystalline, as indicated by, e.g., X-ray powder diffraction measurements. In one embodiment, Form A of Compound 1 has an X-ray powder diffraction pattern substantially as shown in FIG. 2.

In one embodiment, Form A of Compound 1 has one or more characteristic X-ray powder diffraction peaks at a two-theta angle of approximately 11.5, 15.6, 16.6, 17.2, 18.1, 19.0, 19.6, 21.1, 23.2 or 24.8 degrees 2θ as depicted in FIG. 2. In another embodiment, Form A of Compound 1 has one, two, three or four characteristic X-ray powder diffraction peaks at a two-theta angle of approximately 15.6, 16.6, 17.2 or 24.8 degrees 2θ. In another embodiment, Form A of Compound 1 has one, two, three, four, five, six or seven

characteristic X-ray powder diffraction peaks as set forth in Table 1. In another embodiment, Form A of Compound 1 has one, two, or three characteristic X-ray powder diffraction peaks as set forth in Table 1.

In one embodiment, Form A of Compound 1 has the SEM picture as shown in FIG. 3.

In one embodiment, the crystalline form of Compound 1 has a thermogravimetric (TGA) thermograph corresponding substantially to the representative TGA thermogram as depicted in FIG. 4. In certain embodiments, no TGA weight loss is observed for Form A.

In one embodiment, crystalline form A of Compound 1 has a DSC thermogram corresponding substantially as depicted in FIG. 5. In certain embodiments, Form A is characterized by a DSC plot comprising a melting event with an onset temperature of 229° C. and heat of fusion of 118 J/g.

In certain embodiments, Form A is characterized by dynamic vapor sorption analysis. A representative dynamic vapor sorption (DVS) isotherm plot is shown in FIG. 6. In certain embodiments, when the relative humidity ("RH") is increased from about 0% to about 90% RH, Form A exhibits less than 1.5%, less than 1.2% or about 1.2% w/w water uptake. In certain embodiments, Form A comprises less than 0.1% water as determined in a coulometric Karl Fischer (KF) titrator equipped with an oven sample processor set at 225° C.

In certain embodiments, no significant degradation or residual solvent for Form A is observed by ¹H NMR (FIG. 7).

In certain embodiments, Form A of Compound 1 is characterized by its stability profile upon compression. In certain embodiments, Form A is stable, e.g., its XRPD pattern remains substantially unchanged with broader diffraction peaks, upon application of 2000-psi pressure for about 1 minute (FIG. 8).

In still another embodiment, Form A of Compound 1 is substantially pure. In certain embodiments, the substantially pure Form A of Compound 1 is substantially free of other solid forms, e.g., amorphous form. In certain embodiments, the purity of the substantially pure Form A of Compound 1 is no less than about 95% pure, no less than about 96% pure, no less than about 97% pure, no less than about 98% pure, no less than about 98.5% pure, no less than about 99% pure, no less than about 99.5% pure, or no less than about 99.8% pure.

Certain embodiments Form A of Compound 1 is substantially pure. In certain embodiments herein Form A of Compound 1 is substantially free of other solid forms comprising Compound 1 including, e.g., Forms B, C, D, E and/or an amorphous solid form comprising Compound 1. In certain embodiments, Form A is a mixture of solid forms comprising Compound 1, including, e.g., a mixture comprising one or more of the following: Forms B, C, D, E and an amorphous solid form comprising Compound 1.

Form B of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide

In certain embodiments, the lyophilized formulations provided herein are prepared from anhydrous Form B of Compound 1.

In certain embodiments, Form B is obtained by anti-solvent recrystallization from certain solvent systems, for example, solvent systems comprising one or more of the following solvents: methanol/water, DMSO/isopropanol,

DMSO/toluene, and DMSO/water. In certain embodiments, Form B is obtained by cooling recrystallization from THF/water (1:1).

In certain embodiments, Form B is crystalline, as indicated by, e.g., X-ray powder diffraction measurements. In one embodiment, Form B of Compound 1 has an X-ray powder diffraction pattern substantially as shown in FIG. 9.

In one embodiment, Form B of Compound 1 has one or more characteristic X-ray powder diffraction peaks at a two-theta angle of approximately 15.4, 16.3, 16.7, 17.7, 20.4, 25.6 or 27.5, degrees 2θ as depicted in FIG. 9. In another embodiment, Form B of Compound 1 has one, two, three or four characteristic X-ray powder diffraction peaks at a two-theta angle of approximately 16.7, 25.6, 15.4 or 16.3 degrees 2θ. In another embodiment, Form B of Compound 1 has one, two, three, four, five, six or seven characteristic X-ray powder diffraction peaks as set forth in Table 2. In another embodiment, Form B of Compound 1 has one, two, or three characteristic X-ray powder diffraction peaks as set forth in Table 2.

In one embodiment, Form B of Compound 1 has the SEM picture as shown in FIG. 10. In one embodiment, a crystalline form of Compound 1 has a thermogravimetric (TGA) thermograph corresponding substantially to the representative TGA thermogram as depicted in FIG. 11. In certain embodiments, Form B shows no TGA weight loss below 170° C. In certain embodiments, Form B shows a TGA weight loss of 0.4% between 170-230° C.

In one embodiment, crystalline Form B of Compound 1 has a DSC thermogram corresponding substantially as depicted in FIG. 12. In certain embodiments, Form B is characterized by a DSC plot comprising a melt/recrystallization event at 219-224° C. and a major melting event with a peak temperature of 231° C.

In certain embodiments, Form B is characterized by dynamic vapor sorption analysis. A representative dynamic vapor sorption (DVS) isotherm plot is shown in FIG. 13. In certain embodiments, when the relative humidity ("RH") is increased from about 0% to about 90% RH, Form B exhibits about 1.4% w/w water uptake. In certain embodiments, Form B comprises less than 0.1% water as determined in a coulometric Karl Fischer (KF) titrator equipped with an oven sample processor set at 225° C.

In certain embodiments, Form B shows no significant degradation or residual solvent by ¹H NMR (FIG. 14).

In certain embodiments, Form B of Compound 1 is characterized by its stability profile upon compression. In certain embodiments, Form B is stable, e.g., its XRPD pattern remains substantially unchanged with broader diffraction peaks, upon application of 2000-psi pressure for about 1 minute (FIG. 15).

In still another embodiment, Form B of Compound 1 is substantially pure. In certain embodiments, the substantially pure Form B of Compound 1 is substantially free of other solid forms, e.g., amorphous form. In certain embodiments, the purity of the substantially pure Form B of Compound 1 is no less than about 95% pure, no less than about 96% pure, no less than about 97% pure, no less than about 98% pure, no less than about 98.5% pure, no less than about 99% pure, no less than about 99.5% pure, or no less than about 99.8% pure.

Certain embodiments, Form B of Compound 1 is substantially pure. In certain embodiments, Form B of Compound 1 is substantially free of other solid forms comprising Compound 1 including, e.g., Forms A, C, D, E, and/or an amorphous solid form comprising Compound 1. In certain embodiments, Form B is a mixture of solid forms comprising

ing Compound 1, including, e.g., a mixture comprising one or more of the following: Forms A, C, D, E, and an amorphous solid form comprising Compound 1.

Form C of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide

In certain embodiments, the lyophilized formulations provided herein are prepared from anhydrous Form C of Compound 1. In certain embodiments, Form C is the most thermodynamically stable anhydrate among the crystal forms of Compound 1.

In certain embodiments, Form C is obtained by slurring Compound 1 in certain solvent systems, for example, solvent systems comprising one or more of the following solvents: acetonitrile/water, acetone, or ethanol/water for extended period of time.

In certain aspects, Form C is obtained by slurring Form B (1xwt) in acetone (30xvol) at an elevated temperature, for example, from 60-80° C. or 70-75° C. for at least 24 hours, and cooling the mixture to room temperature. In one aspect, the slurring is conducted at a temperature of 70-75° C. under nitrogen pressure of 50-55-psi. In one aspect, the mixture is cooled to room temperature over at least 6 hours.

In certain embodiments, Form C is crystalline, as indicated by, e.g., X-ray powder diffraction measurements. In one embodiment, Form C of Compound 1 has an X-ray powder diffraction pattern substantially as shown in FIG. 16.

In one embodiment, Form C of Compound 1 has one or more characteristic X-ray powder diffraction peaks at a two-theta angle of approximately 7.4, 11.5, 15.8, 16.7, 16.9, 17.7, 18.4, 19.2, 19.5, 21.1, 23.4, 24.7, or 29.9, degrees 2θ as depicted in FIG. 16. In another embodiment, Form C of Compound 1 has one, two, three or four characteristic X-ray powder diffraction peaks at a two-theta angle of approximately 16.7, 16.9, 17.7 or 24.7 degrees 2θ. In another embodiment, Form C of Compound 1 has one, two, three, four, five, six or seven characteristic X-ray powder diffraction peaks as set forth in Table 3. In another embodiment, Form C of Compound 1 has one, two, or three characteristic X-ray powder diffraction peaks as set forth in Table 3.

In one embodiment, Form C of Compound 1 has the SEM picture as shown in FIG. 17. In one embodiment, a crystalline form of Compound 1 has a thermogravimetric (TGA) thermograph corresponding substantially to the representative TGA thermogram as depicted in FIG. 18. In certain embodiments, Form C shows no TGA weight loss.

In one embodiment, crystalline Form C of Compound 1 has a DSC thermogram corresponding substantially as depicted in FIG. 19. In certain embodiments, Form C is characterized by a DSC plot comprising melting event with an onset temperature of 232° C. and heat of fusion of 126 J/g.

In certain embodiments, Form C is characterized by dynamic vapor sorption analysis. A representative dynamic vapor sorption (DVS) isotherm plot is shown in FIG. 20. In certain embodiments, when the relative humidity ("RH") is increased from about 0% to about 90% RH, Form C exhibits about 0.6% w/w water uptake. In certain embodiments, Form C comprises less than 0.1% water as determined in a coulometric Karl Fischer (KF) titrator equipped with an oven sample processor set at 225° C.

In certain embodiments, Form C shows no significant degradation or residual solvent by ¹H NMR (FIG. 21).

In certain embodiments, Form C of Compound 1 is characterized by its stability profile upon compression. In

certain embodiments, Form C is stable, e.g., its XRPD pattern remains substantially unchanged with broader diffraction peaks, upon application of 2000-psi pressure for about 1 minute (FIG. 22).

In still another embodiment, Form C of Compound 1 is substantially pure. In certain embodiments, the substantially pure Form C of Compound 1 is substantially free of other solid forms, e.g., amorphous form. In certain embodiments, the purity of the substantially pure Form C of Compound 1 is no less than about 95% pure, no less than about 96% pure, no less than about 97% pure, no less than about 98% pure, no less than about 98.5% pure, no less than about 99% pure, no less than about 99.5% pure, or no less than about 99.8% pure.

In certain embodiments, Form C of Compound 1 is substantially pure. In certain embodiments, Form C of Compound 1 is substantially free of other solid forms comprising Compound 1 including, e.g., Forms A, B, D, E, and/or an amorphous solid form comprising Compound 1. In certain embodiments, Form C is a mixture of solid forms comprising Compound 1, including, e.g., a mixture comprising one or more of the following: Forms A, B, D, E, and an amorphous solid form comprising Compound 1.

Form D of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide

In certain embodiments, the lyophilized formulations provided herein are prepared from Form D of Compound 1. In certain embodiments, Form D of Compound 1 is a DMSO solvate.

In certain embodiments, Form D is obtained by heating Form B in DMSO/methyl isobutyl ketone and cooling the solution.

In certain embodiments, Form D is crystalline, as indicated by, e.g., X-ray powder diffraction measurements. In one embodiment, Form D of Compound 1 has an X-ray powder diffraction pattern substantially as shown in FIG. 23.

In one embodiment, Form D of Compound 1 has one or more characteristic X-ray powder diffraction peaks at a two-theta angle of approximately 14.1, 14.3, 18.8, 19.1, 23.6 or 24.0 degrees 2θ as depicted in FIG. 23. In another embodiment, Form D of Compound 1 has one, two, three or four characteristic X-ray powder diffraction peaks at a two-theta angle of approximately 14.1, 14.3, 18.8 or 19.1 degrees 2θ. In another embodiment, Form D of Compound 1 has one, two, three, four, five, six or seven characteristic X-ray powder diffraction peaks as set forth in Table 4. In another embodiment, Form D of Compound 1 has one, two, or three characteristic X-ray powder diffraction peaks as set forth in Table 4.

In one embodiment, provided herein is a crystalline form of Compound 1 having a thermogravimetric (TGA) thermograph corresponding substantially to the representative TGA thermogram as depicted in FIG. 24. In certain embodiments, Form D shows TGA weight loss of about 14.1% up to 140° C.

In certain embodiments, Form D comprises DMSO in about 14.3 wt % as measured by gas chromatography.

In still another embodiment, Form D of Compound 1 is substantially pure. In certain embodiments, the substantially pure Form D of Compound 1 is substantially free of other solid forms, e.g., amorphous form. In certain embodiments, the purity of the substantially pure Form D of Compound 1 is no less than about 95% pure, no less than about 96% pure, no less than about 97% pure, no less than about 98% pure,

no less than about 98.5% pure, no less than about 99% pure, no less than about 99.5% pure, or no less than about 99.8% pure.

In certain embodiments Form D of Compound 1 is substantially pure. In certain embodiments, Form D of Compound 1 is substantially free of other solid forms comprising Compound 1 including, e.g., Forms A, B, C, E, and/or an amorphous solid form comprising Compound 1 as provided herein. In certain embodiments, Form D is a mixture of solid forms comprising Compound 1, including, e.g., a mixture comprising one or more of the following: Forms A, B, C, E, and an amorphous solid form comprising Compound 1.

Form E of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide

In certain embodiments, the lyophilized formulations provided herein are prepared from Form E of Compound 1. In certain embodiments, Form E of Compound 1 is a DMSO solvate.

In certain embodiments, Form E is obtained from Form C in DMSO/MIBK or DMSO/IPA or DMSO/anisole at room temperature.

In certain embodiments, Form E is crystalline, as indicated by, e.g., X-ray powder diffraction measurements. In one embodiment, Form E of Compound 1 has an X-ray powder diffraction pattern substantially as shown in FIG. 25.

In one embodiment, Form E of Compound 1 has one or more characteristic X-ray powder diffraction peaks at a two-theta angle of approximately 10.5, 12.5, 16.1, 17.0, 18.5, 21.2, 21.7, 22.6, 22.9, 23.4, 23.8, 24.1, 25.1 or 26.7, degrees 2 θ as depicted in FIG. 25. In another embodiment, Form E of Compound 1 has one, two, three or four characteristic X-ray powder diffraction peaks at a two-theta angle of approximately 16.1, 17.0, 21.2 or 22.9 degrees 2 θ . In another embodiment, Form E of Compound 1 has one, two, three, four, five, six or seven characteristic X-ray powder diffraction peaks as set forth in Table 5. In another embodiment, Form E of Compound 1 has one, two, or three characteristic X-ray powder diffraction peaks as set forth in Table 5.

In one embodiment, provided herein is a crystalline form of Compound 1 having a thermogravimetric (TGA) thermograph corresponding substantially to the representative TGA thermogram as depicted in FIG. 26. In certain embodiments, Form E shows TGA weight loss of about 19.4% up to 120° C. In certain embodiments, Form E shows additional weight loss of 24.9% between 120 and 220° C.

In one embodiment, Form E of Compound 1 is substantially pure. In certain embodiments, the substantially pure Form E of Compound 1 is substantially free of other solid forms, e.g., amorphous form. In certain embodiments, the purity of the substantially pure Form E of Compound 1 is no less than about 95% pure, no less than about 96% pure, no less than about 97% pure, no less than about 98% pure, no less than about 98.5% pure, no less than about 99% pure, no less than about 99.5% pure, or no less than about 99.8% pure.

In certain embodiments, Form E of Compound 1 is substantially pure. In certain embodiments herein, Form E of Compound 1 is substantially free of other solid forms comprising Compound 1 including, e.g., Forms A, B, C, D and/or an amorphous solid form comprising Compound 1. In certain embodiments, Form E is a mixture of solid forms comprising Compound 1, including, e.g., a mixture com-

prising one or more of the following: Forms A, B, C, D and an amorphous solid form comprising Compound 1.

Amorphous Form of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide

In certain embodiments, the lyophilized formulations provided herein comprise amorphous Compound 1.

In certain embodiments, provided herein are methods for making the amorphous form by heating Compound 1 in THE and water and cooling the solution.

In one embodiment, provided herein is an amorphous solid form of Compound 1 having a modulated DSC thermogram as depicted in FIG. 27.

In one embodiment, amorphous Compound 1 has an X-ray powder diffraction pattern substantially as shown in FIG. 28.

In one embodiment, amorphous Compound 1 has a ¹H NMR spectrum substantially as shown in FIG. 29.

In still another embodiment, amorphous Compound 1 is substantially pure. In certain embodiments, the substantially pure amorphous Compound 1 is substantially free of other solid forms, e.g., Form A, Form B, Form C, Form D or Form E. In certain embodiments, the purity of the substantially pure amorphous Compound 1 is no less than about 95% pure, no less than about 96% pure, no less than about 97% pure, no less than about 98% pure, no less than about 98.5% pure, no less than about 99% pure, no less than about 99.5% pure, or no less than about 99.8% pure.

6.3 Exemplary Formulations

Provided herein are stable lyophilized formulations of Compound 1. In one embodiment, the lyophilized formulations of Compound 1 comprise a solid form of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide. In one embodiment, the lyophilized formulations of Compound 1 comprise an amorphous form of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide.

In certain embodiment, the lyophilized formulations provided herein comprise Compound 1, a buffer and a bulking agent. In one embodiment, a lyophilized formulation provided herein comprises about 0.1-2% Compound 1, about 2-15% buffer and about 70-95% bulking agent based on the total weight of the lyophilized formulation.

In one aspect, the lyophilized formulation provided herein comprises Compound 1 in an amount of about 0.1 to about 2% based on the total weight of the lyophilized formulation. In certain embodiments, the amount of Compound 1 is from about 0.1% to about 1.5%, about 0.1% to about 1% or about 0.35% to about 0.9% based on the total weight of the lyophilized formulation. In certain embodiments, the amount of Compound 1 is about 0.1%, 0.2%, 0.3%, 0.35%, 0.36%, 0.4%, 0.5%, 0.6%, 0.7%, 0.8%, 0.9%, or 1.0% based on the total weight of the lyophilized formulation. In one embodiment, the amount of Compound 1 in the lyophilized formulation is about 0.3 to about 0.4% based on the total weight of the lyophilized formulation. In one embodiment, the amount of Compound 1 in the lyophilized formulation is about 0.36% based on the total weight of the lyophilized formulation. In one embodiment, the amount of Compound 1 in the lyophilized formulation is about 0.9 to about 1% based on the total weight of the lyophilized formulation. In one embodiment, the amount of Compound 1 in the

lyophilized formulation is about 0.93% based on the total weight of the lyophilized formulation.

In another aspect is a lyophilized formulation that comprises Compound 1 in an amount of about 0.1 mg to about 5 mg in a 20 cc vial. In still another aspect is a lyophilized formulation that comprises Compound 1 in an amount of about 0.1 mg to about 5 mg, about 0.1 mg to about 4 mg, about 0.1 mg to about 3 mg, about 0.1 mg to about 2 mg, about 0.5 mg to about 5 mg, about 0.5 mg to about 3 mg, about 0.5 mg to about 2 mg, about 0.5 mg to about 1.5 mg in a 20 cc vial. In one aspect Compound 1 is present in an amount of about 0.5, 0.6, 0.7, 0.75, 0.76, 0.8, 0.9, 1.0, 1.2 mg in a 20 cc vial. In one aspect Compound 1 is present in an amount of about 0.76 mg in a 20 cc vial. In one aspect Compound 1 is present in an amount of about 1 mg in a 20 cc vial.

In one aspect, the lyophilized formulations provided herein contain a citrate buffer. In one aspect, the amount of citrate buffer in the formulations provided herein is from about 5% to about 25% based on total weight of the lyophilized formulation. In one aspect, the amount of citrate buffer in the formulations provided herein is about 10, 11, 12, 12.5, 12.7, 12.78, 12.8, 13, 14, 15, 16, 17, 17.3, 17.42, 17.5, 17.7, 18, 19 or 20% based on total weight of the lyophilized formulation. In one aspect, the amount of citrate buffer in the formulations provided herein is about 12.78% based on total weight of the lyophilized formulation. In one aspect, the amount of citrate buffer in the formulations provided herein is about 17.42% based on total weight of the lyophilized formulation.

In one embodiment, the citrate buffer comprises anhydrous citric acid and anhydrous sodium citrate. In certain embodiments, the amount of anhydrous citric acid is from about 2% to about 10%, about 3% to about 9%, about 5% to about 8% or about 6% to about 8% based on total weight of the lyophilized formulation. In certain embodiments, the amount of anhydrous citric acid in the lyophilized formulation is about 2%, 4%, 6%, 6.2%, 6.4%, 6.6%, 6.8%, 7%, 7.3%, 7.4%, 7.5%, 8%, 8.5% or 9% based on total weight of the lyophilized formulation. In one embodiment, the amount of anhydrous citric acid in the lyophilized formulation is about 6%, 6.2%, 6.4%, 6.41%, 6.6%, 6.8% or 7% based on total weight of the lyophilized formulation. In one embodiment, the amount of anhydrous citric acid in the lyophilized formulation is about 7%, 7.3%, 7.4%, 7.43%, 7.5% or 8% based on total weight of the lyophilized formulation. In one embodiment, the amount of anhydrous citric acid in the lyophilized formulation is about 6.41% based on total weight of the lyophilized formulation. In one embodiment, the amount of anhydrous citric acid in the lyophilized formulation is about 7.43% based on total weight of the lyophilized formulation.

In still another aspect is a lyophilized formulation that comprises anhydrous citric acid in an amount of about 5 mg to about 20 mg in a 20 cc vial. In one embodiment, the amount of anhydrous citric acid is about 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 mg in a 20 cc vial. In one embodiment, the amount of anhydrous citric acid is about 17.7 mg in a 20 cc vial. In one embodiment, the amount of anhydrous citric acid is about 6.1 mg in a 20 cc vial.

In certain embodiments, the amount of anhydrous sodium citrate is from about 2% to about 15%, about 4% to about 15% or about 5% to about 10% based on total weight of the lyophilized formulation. In certain embodiments, the amount of anhydrous sodium citrate in the lyophilized formulation is about 2%, 3%, 4%, 5%, 6%, 6.2%, 6.37%, 6.4%, 6.6%, 6.8%, 7%, 7.5%, 8%, 8.5%, 9%, 9.5%, 10%,

12% or about 15% based on total weight of the lyophilized formulation. In one embodiment, the amount of anhydrous sodium citrate in the lyophilized formulation is about 6%, 6.2%, 6.37%, 6.4%, 6.6%, 6.8% or 7% based on total weight of the lyophilized formulation. In one embodiment, the amount of anhydrous sodium citrate in the lyophilized formulation is about 8%, 8.5%, 9%, 9.5%, 9.99%, 10% or 10.5% based on total weight of the lyophilized formulation. In one embodiment, the amount of anhydrous sodium citrate in the lyophilized formulation is about 6.37% based on total weight of the lyophilized formulation. In one embodiment, the amount of anhydrous sodium citrate in the lyophilized formulation is about 9.99% based on total weight of the lyophilized formulation.

In still another aspect is a lyophilized formulation that comprises anhydrous sodium citrate in an amount of about 5 mg to about 20 mg in a 20 cc vial. In one embodiment, the amount of anhydrous sodium citrate is about 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 mg in a 20 cc vial. In one embodiment, the amount of anhydrous sodium citrate is about 17.6 mg in a 20 cc vial. In one embodiment, the amount of anhydrous sodium citrate is about 8.2 mg in a 20 cc vial.

In certain embodiments, the amount of anhydrous citric acid in the lyophilized formulation is about 2%, 4%, 6%, 6.2%, 6.4%, 6.6%, 6.8%, 7%, 7.3%, 7.4%, 7.5%, 8%, 8.5% or 9% and the amount of anhydrous sodium citrate in the lyophilized formulation is about 2%, 3%, 4%, 5%, 6%, 6.2%, 6.4%, 6.6%, 6.8%, 7%, 7.5%, 8%, 8.5%, 9%, 9.5%, 10%, 12% or about 15% based on total weight of the lyophilized formulation. In one embodiment, the amount of anhydrous citric acid in the lyophilized formulation is about 6%, 6.2%, 6.4%, 6.6%, 6.8% or 7% and the amount of anhydrous sodium citrate in the lyophilized formulation is about 6%, 6.2%, 6.4%, 6.6%, 6.8% or 7% based on total weight of the lyophilized formulation. In one embodiment, the amount of anhydrous citric acid in the lyophilized formulation is about 7%, 7.3%, 7.4%, 7.5% or 8% and the amount of anhydrous sodium citrate in the lyophilized formulation is about 8%, 8.5%, 9%, 9.5%, 10% or 10.5% based on total weight of the lyophilized formulation. In one embodiment, the amount of anhydrous citric acid is about 6.1 mg and the amount of anhydrous sodium citrate is about 8.2 mg in a 20 cc vial. In one embodiment, the amount of anhydrous citric acid is about 17.7 mg and the amount of anhydrous sodium citrate is about 17.6 mg in a 20 cc vial.

In one aspect, the bulking agent in the lyophilized formulations provided herein comprises Captisol®, mannitol or Kleptose®, for example, β -cyclodextrin, hydroxypropyl β -cyclodextrin and methylated β -cyclodextrin. In certain embodiments, the bulking agent in the lyophilized formulations provided herein comprises Kleptose® hydroxypropyl β -cyclodextrins (Kleptose®HPB). In certain embodiments, the amount of the bulking agent in the lyophilized compositions provided herein is from about 70% to about 95%, about 75% to about 90% or about 80% to about 90% based on total weight of the lyophilized formulation. In certain embodiments, the amount of hydroxypropyl β -cyclodextrin in the lyophilized compositions provided herein is from about 70% to about 95%, about 75% to about 90% or about 80% to about 90% based on total weight of the lyophilized formulation. In certain embodiments, the amount of hydroxypropyl β -cyclodextrin in the lyophilized compositions provided herein is about 75%, 80%, 81%, 81.61%, 82%, 83%, 84%, 85%, 86%, 86.86%, 87%, 88%, 89% or 90% based on total weight of the lyophilized formulation. In one embodiment, the amount of hydroxy-

propyl β -cyclodextrin in the lyophilized compositions provided herein is about 86.86% based on total weight of the lyophilized formulation. In one embodiment, the amount of hydroxypropyl β -cyclodextrin in the lyophilized compositions provided herein is about 81.61% based on total weight of the lyophilized formulation.

In another aspect is a lyophilized formulation that comprises Kleptose®HPB in an amount of about 67 mg in a 20 cc vial. In still another aspect is a lyophilized formulation that comprises Kleptose®HPB in an amount of about 240 mg in a 20 cc vial.

In certain embodiments, the lyophilized formulation upon reconstitution has a pH of about 4 to 5. In one embodiment, the lyophilized formulation upon reconstitution has a pH of about 4, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9 or 5.

In certain embodiments, provided herein is a container comprising a lyophilized composition provided herein. In one aspect, the container is a glass vial. In one aspect, the container is a 20 cc glass vial.

In certain embodiments, the lyophilized formulation has a composition as described in the Table 21. In certain embodiments, the lyophilized formulation has a composition as described in the Table 34.

The lyophilized formulations of Compound 1 provided herein can be administered to a patient in need thereof using standard therapeutic methods for delivering Compound 1 including, but not limited to, the methods described herein. In one embodiment, the lyophilized formulations provided herein are reconstituted in a pharmaceutically acceptable solvent to produce a pharmaceutically acceptable solution, wherein the solution is administered (such as by intravenous injection) to the patient.

The lyophilized formulation provided herein can be constituted for parenteral administration to a patient using any pharmaceutically acceptable diluent. Such diluents include, but are not limited to Sterile Water for Injection (SWFI), Dextrose 5% in Water (D5W), or a cosolvent system. Any quantity of diluent may be used to constitute the lyophilized formulation such that a suitable solution for injection is prepared. Accordingly, the quantity of the diluent must be sufficient to dissolve the lyophilized formulation. In one embodiment, 1-5 mL or 1 to 3 mL of a diluent are used to constitute the lyophilized formulation to yield a final concentration of, about 0.1-5 mg/mL, about 0.1-1 mg/mL, about 0.5-1 mg/mL of Compound 1. In certain embodiments, the final concentration of Compound 1 in the reconstituted solution is about 0.5 mg/mL. In certain embodiment, the volume of the reconstitution diluent varies between 2 ml and 20 ml to yield a final concentration of 0.05-0.5 mg/mL. In certain embodiment, depending on the required dose, multiple vials may be used for reconstitution.

The constituted solutions of lyophilized formulation can be stored and used within up to about 24 hours, about 12 hours or about 8 hours. In some embodiments, the solution is used within 8 hour of preparation. In some embodiments, the solution is used within 5 hour of preparation. In some embodiments, the solution is used within 1 hour of preparation.

The lyophilized formulation can be a formulation as set forth in Table 21 and/or Table 34. Thus, in certain embodiments, the lyophilized formulation is represented by the designations in Table 21 and/or Table 34 (e.g., Formulation IA, Formulation IC, Formulation II, Formulation III, Formulation IX, or Formulation ID). In one embodiment, the formulation is Formulation IX. In one embodiment, the formulation is Formulation IC. In one embodiment, the formulation is Formulation ID.

In one aspect provided herein is a lyophilized formulation in a 20 cc vial that includes: Compound 1 at an amount that provides 1 mg 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide and a pharmaceutically acceptable carrier or excipient that includes a buffer and bulking agent as described herein. The buffer and bulking agent can be present at an amount as described herein.

In one aspect provided herein is a lyophilized formulation in a 20 cc vial that includes: Compound 1 at an amount that provides 1 mg 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide, 17.7 mg anhydrous citric acid, 17.6 mg anhydrous sodium citrate and 240 mg HPB as described herein. In one embodiment, the lyophilized formulation in a 20 cc vial is reconstituted with 2 mL sterile water for injection.

In one aspect provided herein is an aqueous composition comprising a lyophilized formulation provided herein. In one embodiment, the aqueous solution comprises 0.5 mg/mL Compound 1.

6.4 Process for Making Formulations

The lyophilized formulations provided herein can be prepared by any of the methods known in the art and as described herein, but all methods include the step of bringing the active ingredient into association with the pharmaceutically acceptable excipient, which constitutes one or more necessary ingredients (such as buffer and bulking agent).

In one aspect, the formulations provided herein are prepared by dissolving Compound 1 and a bulking agent in a citrate buffer to obtain a solution and lyophilizing the solution. A flow chart illustrating an exemplary process is provided in FIG. 32. In one embodiment, the process comprises dissolving Kleptose® HPB in a 20 mM, pH 4.3 citrate buffer to obtain a mixture, adding Compound 1 dissolved in DMA to the mixture to obtain a solution, filtering the solution into a 20 cc vial, and lyophilizing the solution. In one embodiment, the solution is filtered through one or more 0.45 μ m and/or 0.22 μ m filters. In one embodiment, the vial is sealed under nitrogen after lyophilization.

In one aspect, the lyophilization process contains three stages: freezing, primary drying, and secondary drying. A liquid formulation is transformed to a lyophilized powder form by going through complete solidification through freezing stage, sublimation of ice and solvents through primary drying, and desorption of residual moisture and solvents through secondary drying. The shelf temperature and chamber pressure in the primary drying and secondary drying are controlled to obtained the desired quality of the finished drug product. In one aspect of the process, the cake appearance and structure was characterized by visual inspection.

6.5 Kits

Pharmaceutical packs or kits which comprise pharmaceutical compositions or dosage forms provided herein are also provided. Exemplary kits include notice in the form prescribed by a governmental agency regulating the manufacture, use or sale of pharmaceuticals products, which notice reflects approval by the agency of manufacture, use or sale for human administration

6.6 Methods of Treating

In one embodiment, provided herein is a method of treating and preventing cancer, which comprises administering to a patient a lyophilized formulation of Compound 1 provided herein.

In another embodiment, provided herein is method of managing cancer, which comprises administering to a patient a lyophilized formulation of Compound 1 provided herein.

Also provided herein are methods of treating patients who have been previously treated for cancer but are non-responsive to standard therapies, as well as those who have not previously been treated. The invention also encompasses methods of treating patients regardless of patient's age, although some diseases or disorders are more common in certain age groups. The invention further encompasses methods of treating patients who have undergone surgery in an attempt to treat the disease or condition at issue, as well as those who have not. Because patients with cancer have heterogeneous clinical manifestations and varying clinical outcomes, the treatment given to a patient may vary, depending on his/her prognosis. The skilled clinician will be able to readily determine without undue experimentation specific secondary agents, types of surgery, and types of non-drug based standard therapy that can be effectively used to treat an individual patient with cancer.

As used herein, the term "cancer" includes, but is not limited to, solid tumors and blood borne tumors. The term "cancer" refers to disease of skin tissues, organs, blood, and vessels, including, but not limited to, cancers of the bladder, bone, blood, brain, breast, cervix, chest, colon, endometrium, esophagus, eye, head, kidney, liver, lymph nodes, lung, mouth, neck, ovaries, pancreas, prostate, rectum, stomach, testis, throat, and uterus. Specific cancers include, but are not limited to, advanced malignancy, amyloidosis, neuroblastoma, meningioma, hemangiopericytoma, multiple brain metastase, glioblastoma multiforms, glioblastoma, brain stem glioma, poor prognosis malignant brain tumor, malignant glioma, recurrent malignant glioma, anaplastic astrocytoma, anaplastic oligodendroglioma, neuroendocrine tumor, rectal adenocarcinoma, colorectal cancer, including stage 3 and stage 4, unresectable colorectal carcinoma, metastatic hepatocellular carcinoma, Kaposi's sarcoma, karotype acute myeloblastic leukemia, Hodgkin's lymphoma, non-Hodgkin's lymphoma, cutaneous T-Cell lymphoma, cutaneous B-Cell lymphoma, diffuse large B-Cell lymphoma, low grade follicular lymphoma, malignant melanoma, malignant mesothelioma, malignant pleural effusion mesothelioma syndrome, peritoneal carcinoma, papillary serous carcinoma, gynecologic sarcoma, soft tissue sarcoma, scleroderma, cutaneous vasculitis, Langerhans cell histiocytosis, leiomyosarcoma, fibrodysplasia ossificans progressive, hormone refractory prostate cancer, resected high-risk soft tissue sarcoma, unresectable hepatocellular carcinoma, Waldenstrom's macroglobulinemia, smoldering myeloma, indolent myeloma, fallopian tube cancer, androgen independent prostate cancer, androgen dependent stage IV non-metastatic prostate cancer, hormone-insensitive prostate cancer, chemotherapy-insensitive prostate cancer, papillary thyroid carcinoma, follicular thyroid carcinoma, medullary thyroid carcinoma, and leiomyoma.

In certain embodiments, the cancer is a solid tumor. In certain embodiments, the solid tumor is metastatic. In certain embodiments, the solid tumor is drug-resistant. In certain embodiments, the solid tumor is hepatocellular carcinoma, prostate cancer, ovarian cancer, or glioblastoma.

In certain embodiments, the cancer is a blood borne tumor. In certain embodiments, the blood borne tumor is metastatic. In certain embodiments, the blood borne tumor is drug resistant. In certain embodiments, the cancer is leukemia. In another embodiment, the cancer is MDS.

In one embodiment, methods provided herein encompass treating, preventing and/or managing various types of leukemias such as chronic lymphocytic leukemia (CLL), chronic myelocytic leukemia (CML), acute lymphoblastic leukemia (ALL), acute myeloid leukemia (AML), and acute myeloblastic leukemia (AML) by administering a therapeutically effective amount of a lyophilized formulation provided herein.

In some embodiments, the methods provided herein encompass treating, preventing and/or managing acute leukemia in a subject. In some embodiments, the acute leukemia is acute myeloid leukemia (AML), which includes, but is not limited to, undifferentiated AML (M0), myeloblastic leukemia (M1), myeloblastic leukemia (M2), promyelocytic leukemia (M3 or M3 variant (M3V)), myelomonocytic leukemia (M4 or M4 variant with eosinophilia (M4E)), monocytic leukemia (M5), erythroleukemia (M6), and megakaryoblastic leukemia (M7). In one embodiment, the acute myeloid leukemia is undifferentiated AML (M0). In one embodiment, the acute myeloid leukemia is myeloblastic leukemia (M1). In one embodiment, the acute myeloid leukemia is myeloblastic leukemia (M2). In one embodiment, the acute myeloid leukemia is promyelocytic leukemia (M3 or M3 variant (M3V)). In one embodiment, the acute myeloid leukemia is myelomonocytic leukemia (M4 or M4 variant with eosinophilia (M4E)). In one embodiment, the acute myeloid leukemia is monocytic leukemia (M5). In one embodiment, the acute myeloid leukemia is erythroleukemia (M6). In one embodiment, the acute myeloid leukemia is megakaryoblastic leukemia (M7).

In certain embodiments, the methods of treating, preventing and/or managing acute myeloid leukemia in a subject comprise the step of administering to the subject an amount of a lyophilized formulation of Compound 1 provided herein effective to treat, prevent and/or manage acute myeloid leukemia alone or in combination.

In one embodiment, provided herein are methods of treating, preventing and/or managing acute myeloid leukemia by intravenous administration of a lyophilized formulation of Compound 1. In one embodiment, the a lyophilized formulation of Compound 1 is dissolved in water to form an aqueous solution for intravenous administration in methods of treating, preventing and/or managing acute myeloid leukemia provided herein.

In some embodiments, the methods comprise the step of administering to the subject a lyophilized formulation of Compound 1 provided herein in combination with a second active agent in amounts effective to treat, prevent and/or manage acute myeloid leukemia.

In some embodiments, the methods provided herein encompass treating, preventing and/or managing acute lymphocytic leukemia (ALL) in a subject. In some embodiments, acute lymphocytic leukemia includes leukemia that originates in the blast cells of the bone marrow (B-cells), thymus (T-cells), and lymph nodes. The acute lymphocytic leukemia can be categorized according to the French-American-British (FAB) Morphological Classification Scheme as L1—Mature-appearing lymphoblasts (T-cells or pre-B-cells), L2—Immature and pleomorphic (variously shaped) lymphoblasts (T-cells or pre-B-cells), and L3—Lymphoblasts (B-cells; Burkitt's cells). In one embodiment, the acute lymphocytic leukemia originates in the blast cells of the bone marrow (B-cells). In one embodiment, the acute lymphocytic leukemia originates in the thymus (T-cells). In one embodiment, the acute lymphocytic leukemia originates in the lymph nodes. In one embodiment, the acute lymphocytic leukemia is L1 type characterized by mature-appearing

lymphoblasts (T-cells or pre-B-cells). In one embodiment, the acute lymphocytic leukemia is L2 type characterized by immature and pleomorphic (variously shaped) lymphoblasts (T-cells or pre-B-cells). In one embodiment, the acute lymphocytic leukemia is L3 type characterized by lymphoblasts (B-cells; Burkitt's cells). In certain embodiments, the acute lymphocytic leukemia is T-cell leukemia. In one embodiment, the T-cell leukemia is peripheral T-cell leukemia. In another embodiment, the T-cell leukemia is T-cell lymphoblastic leukemia. In another embodiment, the T-cell leukemia is cutaneous T-cell leukemia. In another embodiment, the T-cell leukemia is adult T-cell leukemia. Thus, the methods of treating, preventing and/or managing acute lymphocytic leukemia in a subject comprise the step of administering to the subject an amount of a lyophilized formulation of Compound 1 provided herein effective to treat, prevent and/or manage acute lymphocytic leukemia alone or in combination with a second active agent. In some embodiments, the methods comprise the step of administering to the subject a lyophilized formulation of Compound 1 provided herein in combination with a second active agent in amounts effective to treat, prevent and/or manage acute lymphocytic leukemia.

In some embodiments, the methods provided herein encompass treating, preventing and/or managing chronic myelogenous leukemia (CML) in a subject. The methods comprise the step of administering to the subject an amount of a lyophilized formulation of Compound 1 provided herein effective to treat, prevent and/or manage chronic myelogenous leukemia. In some embodiments, the methods comprise the step of administering to the subject a lyophilized formulation of Compound 1 provided herein in combination with a second active agent in amounts effective to treat, prevent and/or manage chronic myelogenous leukemia.

In some embodiments, the methods provided herein encompass treating, preventing and/or managing chronic lymphocytic leukemia (CLL) in a subject. The methods comprise the step of administering to the subject an amount of a lyophilized formulation of Compound 1 provided herein effective to treat, prevent and/or manage chronic lymphocytic leukemia. In some embodiments, the methods comprise the step of administering to the subject a lyophilized formulation of Compound 1 provided herein in combination with a second active agent in amounts effective to treat, prevent and/or manage chronic lymphocytic leukemia.

In certain embodiments, provided herein are methods of treating, preventing, and/or managing disease in patients with impaired renal function. In certain embodiments, provided herein are method of treating, preventing, and/or managing cancer in patients with impaired renal function. In certain embodiments, provided herein are methods of providing appropriate dose adjustments for patients with impaired renal function due to, but not limited to, disease, aging, or other patient factors.

In certain embodiments, provided herein are methods of treating, preventing, and/or managing lymphoma, including non-Hodgkin's lymphoma. In some embodiments, provided herein are methods for the treatment and/or management of non-Hodgkin's lymphoma (NHL), including but not limited to, diffuse large B-cell lymphoma (DLBCL), using prognostic factors.

In certain embodiments, provided herein are methods of treating, preventing, and/or managing multiple myeloma, including relapsed/refractory multiple myeloma in patients with impaired renal function or a symptom thereof, comprising administering a therapeutically effective amount of a

lyophilized formulation of Compound 1 provided herein to a patient having relapsed/refractory multiple myeloma with impaired renal function.

In one embodiment, provided herein are methods of treating, preventing, and/or managing a myelodysplastic syndrome (MDS) in a subject. The methods comprise the step of administering to the subject a therapeutically active amount of a lyophilized formulation of Compound 1 provided herein. In one embodiment, the MDS is relapsed, resistant or refractory MDS. In one embodiment, MDS is selected from refractory anemia (RA); RA with ringed sideroblasts (RARS); RA with excess of blasts (RAEB); refractory cytopenia with multilineage dysplasia (RCMD); refractory cytopenia with unilineage dysplasia (RCUD); unclassifiable myelodysplastic syndrome (MDS-U), myelodysplastic syndrome associated with an isolated del(5q) chromosome abnormality, therapy-related myeloid neoplasms and chronic myelomonocytic leukemia (CMML). In some embodiments, the methods comprise the step of administering to the subject a lyophilized formulation of Compound 1 provided herein in combination with a second active agent in amounts effective to treat, prevent and/or manage MDS.

In certain embodiments, a therapeutically or prophylactically effective amount of Compound 1 is from about 0.005 to about 1,000 mg per day, from about 0.01 to about 500 mg per day, from about 0.01 to about 250 mg per day, from about 0.01 to about 100 mg per day, from about 0.1 to about 100 mg per day, from about 0.5 to about 100 mg per day, from about 1 to about 100 mg per day, from about 0.01 to about 50 mg per day, from about 0.1 to about 50 mg per day, from about 0.5 to about 50 mg per day, from about 1 to about 50 mg per day, from about 0.02 to about 25 mg per day, from about 0.05 to about 10 mg per day, from about 0.05 to about 5 mg per day, from about 0.1 to about 5 mg per day, or from about 0.5 to about 5 mg per day.

In certain embodiments, the therapeutically or prophylactically effective amount is about 0.1, about 0.2, about 0.5, about 1, about 2, about 3, about 4, about 5, about 6, about 7, about 8, about 9, about 10, about 15, about 20, about 25, about 30, about 40, about 45, about 50, about 60, about 70, about 80, about 90, about 100, or about 150 mg per day. In some such embodiments, the therapeutically or prophylactically effective amount is about 2, about 3, about 4, about 5, about 6 or about 7 mg per day.

In one embodiment, the recommended daily dose range of Compound 1, for the conditions described herein lie within the range of from about 0.05 mg to about 50 mg per day, preferably given as a single once-a-day dose, or in divided doses throughout a day. In some embodiments, the dosage ranges from about 1 mg to about 50 mg per day. In other embodiments, the dosage ranges from about 0.5 to about 5 mg per day. Specific doses per day include 0.1, 0.2, 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49 or 50 mg per day.

In a specific embodiment, the recommended starting dosage may be 0.1, 0.5, 1, 2, 3, 4, 5, 10, 15, 20, 25 or 50 mg per day. In another embodiment, the recommended starting dosage may be 0.1, 0.5, 1, 2, 3, 4, or 5 mg per day. The dose may be escalated to 15, 20, 25, 30, 35, 40, 45 and 50 mg/day. In a specific embodiment, Compound 1 can be administered in an amount of about 25 mg/day to patients with leukemia, including AML. In a particular embodiment, Compound 1 can be administered in an amount of about 10 mg/day to patients with leukemia, including AML. In a particular

embodiment, Compound 1 can be administered in an amount of about 5 mg/day to patients with leukemia, including AML. In a particular embodiment, Compound 1 can be administered in an amount of about 4 mg/day to patients with leukemia, including AML. In a particular embodiment, Compound 1 provided herein can be administered in an amount of about 3 mg/day to patients with leukemia, including AML. In a particular embodiment, Compound 1 provided herein can be administered in an amount of about 2 mg/day to patients with leukemia, including AML. In a particular embodiment, Compound 1 provided herein can be administered in an amount of about 1 mg/day to patients with leukemia, including AML. In a particular embodiment, Compound 1 provided herein can be administered in an amount of about 0.5 mg/day to patients with leukemia, including AML.

In a specific embodiment, Compound 1 can be administered in an amount of about 25 mg/day to patients with MDS. In a particular embodiment, Compound 1 can be administered in an amount of about 10 mg/day to patients with MDS. In a particular embodiment, Compound 1 can be administered in an amount of about 5 mg/day to patients with MDS. In a particular embodiment, Compound 1 can be administered in an amount of about 4 mg/day to patients with MDS. In a particular embodiment, Compound 1 provided herein can be administered in an amount of about 3 mg/day to patients with MDS. In a particular embodiment, Compound 1 provided herein can be administered in an amount of about 2 mg/day to patients with MDS. In a particular embodiment, Compound 1 provided herein can be administered in an amount of about 1 mg/day to patients with MDS. In a particular embodiment, Compound 1 provided herein can be administered in an amount of about 0.5 mg/day to patients with MDS.

In certain embodiments, the therapeutically or prophylactically effective amount is from about 0.001 to about 100 mg/kg/day, from about 0.01 to about 50 mg/kg/day, from about 0.01 to about 25 mg/kg/day, from about 0.01 to about 10 mg/kg/day, from about 0.01 to about 9 mg/kg/day, 0.01 to about 8 mg/kg/day, from about 0.01 to about 7 mg/kg/day, from about 0.01 to about 6 mg/kg/day, from about 0.01 to about 5 mg/kg/day, from about 0.01 to about 4 mg/kg/day, from about 0.01 to about 3 mg/kg/day, from about 0.01 to about 2 mg/kg/day, from about 0.01 to about 1 mg/kg/day, or from about 0.01 to about 0.05 mg/kg/day.

The administered dose can also be expressed in units other than mg/kg/day. For example, doses for parenteral administration can be expressed as mg/m²/day. One of ordinary skill in the art would readily know how to convert doses from mg/kg/day to mg/m²/day to given either the height or weight of a subject or both (see, www.fda.gov/cder/cancer/animalframe.htm). For example, a dose of 1 mg/kg/day for a 65 kg human is approximately equal to 38 mg/m²/day.

In certain embodiments, the amount of Compound 1 administered is sufficient to provide a plasma concentration of the compound at steady state, ranging from about 0.001 to about 500 μ M, about 0.002 to about 200 μ M, about 0.005 to about 100 μ M, about 0.01 to about 50 μ M, from about 1 to about 50 μ M, about 0.02 to about 25 μ M, from about 0.05 to about 20 μ M, from about 0.1 to about 20 μ M, from about 0.5 to about 20 μ M, or from about 1 to about 20 μ M.

In other embodiments, the amount of a lyophilized formulation of Compound 1 administered is sufficient to provide a plasma concentration of the compound at steady state, ranging from about 5 to about 100 nM, about 5 to about 50

nM, about 10 to about 100 nM, about 10 to about 50 nM or from about 50 to about 100 nM.

As used herein, the term "plasma concentration at steady state" is the concentration reached after a period of administration of a lyophilized formulation provided herein. Once steady state is reached, there are minor peaks and troughs on the time dependent curve of the plasma concentration of the solid form.

In certain embodiments, the amount of a lyophilized formulation of Compound 1 administered is sufficient to provide a maximum plasma concentration (peak concentration) of the compound, ranging from about 0.001 to about 500 μ M, about 0.002 to about 200 μ M, about 0.005 to about 100 μ M, about 0.01 to about 50 μ M, from about 1 to about 50 μ M, about 0.02 to about 25 μ M, from about 0.05 to about 20 μ M, from about 0.1 to about 20 μ M, from about 0.5 to about 20 μ M, or from about 1 to about 20 μ M.

In certain embodiments, the amount of a lyophilized formulation of Compound 1 administered is sufficient to provide a minimum plasma concentration (trough concentration) of the compound, ranging from about 0.001 to about 500 μ M, about 0.002 to about 200 μ M, about 0.005 to about 100 μ M, about 0.01 to about 50 μ M, from about 1 to about 50 μ M, about 0.01 to about 25 μ M, from about 0.01 to about 20 μ M, from about 0.02 to about 20 μ M, from about 0.02 to about 20 μ M, or from about 0.01 to about 20 μ M.

In certain embodiments, the amount of a lyophilized formulation of Compound 1 administered is sufficient to provide an area under the curve (AUC) of the compound, ranging from about 100 to about 100,000 ng*hr/mL, from about 1,000 to about 50,000 ng*hr/mL, from about 5,000 to about 25,000 ng*hr/mL, or from about 5,000 to about 10,000 ng*hr/mL.

In certain embodiments, the patient to be treated with one of the methods provided herein has not been treated with anticancer therapy prior to the administration of a lyophilized formulation of Compound 1 provided herein. In certain embodiments, the patient to be treated with one of the methods provided herein has been treated with anticancer therapy prior to the administration of a lyophilized formulation of Compound 1 provided herein. In certain embodiments, the patient to be treated with one of the methods provided herein has developed drug resistance to the anticancer therapy.

The methods provided herein encompass treating a patient regardless of patient's age, although some diseases or disorders are more common in certain age groups.

The lyophilized formulation of Compound 1 provided herein can be delivered as a single dose such as, e.g., a single bolus injection, or over time, such as, e.g., continuous infusion over time or divided bolus doses over time. The lyophilized formulation of Compound 1 can be administered repeatedly if necessary, for example, until the patient experiences stable disease or regression, or until the patient experiences disease progression or unacceptable toxicity. For example, stable disease for solid tumors generally means that the perpendicular diameter of measurable lesions has not increased by 25% or more from the last measurement. Response Evaluation Criteria in Solid Tumors (RECIST) Guidelines, *Journal of the National Cancer Institute* 92(3): 205-216 (2000). Stable disease or lack thereof is determined by methods known in the art such as evaluation of patient symptoms, physical examination, visualization of the tumor that has been imaged using X-ray, CAT, PET, or MRI scan and other commonly accepted evaluation modalities.

The a lyophilized formulation of Compound 1 provided herein can be administered once daily (QD), or divided into multiple daily doses such as twice daily (BID), three times daily (TID), and four times daily (QID). In addition, the administration can be continuous (i.e., daily for consecutive days or every day), intermittent, e.g., in cycles (i.e., including days, weeks, or months of rest without drug). As used herein, the term "daily" is intended to mean that a therapeutic compound, is administered once or more than once each day, for example, for a period of time. The term "continuous" is intended to mean that a therapeutic compound, is administered daily for an uninterrupted period of at least 10 days to 52 weeks. The term "intermittent" or "intermittently" as used herein is intended to mean stopping and starting at either regular or irregular intervals. For example, intermittent administration of the lyophilized formulation of Compound 1 is administration for one to six days per week, administration in cycles (e.g., daily administration for one to ten consecutive days of a 28 day cycle, then a rest period with no administration for rest of the 28 day cycle or daily administration for two to eight consecutive weeks, then a rest period with no administration for up to one week), or administration on alternate days. The term "cycling" as used herein is intended to mean that a therapeutic compound is administered daily or continuously but with a rest period. In some such embodiments, administration is once a day for two to six days, then a rest period with no administration for five to seven days. In some other such embodiments, administration is once a day for the first two to five or ten days of a 28 day cycle, followed by a rest period with no administration for the rest of the 28 day cycle.

In some embodiments, the frequency of administration is in the range of about a daily dose to about a monthly dose. In certain embodiments, administration is once a day, twice a day, three times a day, four times a day, once every other day, twice a week, once every week, once every two weeks, once every three weeks, or once every four weeks. In one embodiment, Compound 1 is administered once a day. In another embodiment, Compound 1 is administered twice a day. In yet another embodiment, Compound 1 provided herein is administered three times a day. In still another embodiment, Compound 1 provided herein is administered four times a day.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered once per day from one day to six months, from one week to three months, from one week to four weeks, from one week to three weeks, or from one week to two weeks. In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered once per day for one week, two weeks, three weeks, or four weeks. In one embodiment, a lyophilized formulation of Compound 1 provided herein is administered once per day for 1 day. In one embodiment, a lyophilized formulation of Compound 1 provided herein is administered once per day for 2 days. In one embodiment, a lyophilized formulation of Compound 1 provided herein is administered once per day for 3 days. In one embodiment, a lyophilized formulation of Compound 1 provided herein is administered once per day for 4 days. In one embodiment, a lyophilized formulation of Compound 1 provided herein is administered once per day for 5 days. In one embodiment, a lyophilized formulation of Compound 1 provided herein is administered once per day for 6 days. In one embodiment, a lyophilized formulation of Compound 1 provided herein is administered once per day for one week. In one embodiment, a lyophilized formulation of Compound 1 provided herein is administered once per day for up to 10 days. In another

embodiment, a lyophilized formulation of Compound 1 provided herein is administered once per day for two weeks. In yet another embodiment, a lyophilized formulation of Compound 1 provided herein is administered once per day for three weeks. In still another embodiment, a lyophilized formulation of Compound 1 provided herein is administered once per day for four weeks.

6.6.1 Combination Therapy

The lyophilized formulation of Compound 1 provided herein can also be combined or used in combination with other therapeutic agents useful in the treatment and/or prevention of cancer described herein.

In one embodiment, provided herein is a method of treating, preventing, and/or managing cancer, comprising administering to a patient a lyophilized formulation of Compound 1 provided herein in combination with one or more second active agents, and optionally in combination with radiation therapy, blood transfusions, or surgery. Examples of second active agents are disclosed herein.

A lyophilized formulation of Compound 1 provided herein can also be combined or used in combination with other therapeutic agents useful in the treatment and/or prevention of MDS described herein.

In one embodiment, provided herein is a method of treating, preventing, and/or managing MDS, comprising administering to a patient a lyophilized formulation of Compound 1 provided herein in combination with one or more second active agents, and optionally in combination with radiation therapy, blood transfusions, or surgery. Examples of second active agents are disclosed herein.

As used herein, the term "in combination" includes the use of more than one therapy (e.g., one or more prophylactic and/or therapeutic agents). However, the use of the term "in combination" does not restrict the order in which therapies (e.g., prophylactic and/or therapeutic agents) are administered to a patient with a disease or disorder. A first therapy (e.g., a prophylactic or therapeutic agent such as a lyophilized formulation of Compound 1 provided herein, can be administered prior to (e.g., 5 minutes, 15 minutes, 30 minutes, 45 minutes, 1 hour, 2 hours, 4 hours, 6 hours, 12 hours, 24 hours, 48 hours, 72 hours, 96 hours, 1 week, 2 weeks, 3 weeks, 4 weeks, 5 weeks, 6 weeks, 8 weeks, or 12 weeks before), concomitantly with, or subsequent to (e.g., 5 minutes, 15 minutes, 30 minutes, 45 minutes, 1 hour, 2 hours, 4 hours, 6 hours, 12 hours, 24 hours, 48 hours, 72 hours, 96 hours, 1 week, 2 weeks, 3 weeks, 4 weeks, 5 weeks, 6 weeks, 8 weeks, or 12 weeks after) the administration of a second therapy (e.g., a prophylactic or therapeutic agent) to the subject. Triple therapy is also contemplated herein.

Administration of a lyophilized formulation of Compound 1 provided herein and one or more second active agents to a patient can occur simultaneously or sequentially by the same or different routes of administration. The suitability of a particular route of administration employed for a particular active agent will depend on the active agent itself (e.g., whether it can be administered orally without decomposing prior to entering the blood stream) and the cancer being treated.

The route of administration of a lyophilized formulation of Compound 1 is independent of the route of administration of a second therapy. Thus, in accordance with these embodiments, a lyophilized formulation of Compound 1 is administered intravenously, and the second therapy can be administered orally, parenterally, intraperitoneally, intravenously, intraarterially, transdermally, sublingually, intramuscularly, rectally, transbuccally, intranasally, liposomally, via inhala-

tion, vaginally, intraocularly, via local delivery by catheter or stent, subcutaneously, intraadiposally, intraarticularly, intrathecally, or in a slow release dosage form. In one embodiment, a lyophilized formulation of Compound 1 and a second therapy are administered by the same mode of administration, by IV. In another embodiment, a lyophilized formulation of Compound 1 is administered by one mode of administration, e.g., by IV, whereas the second agent (an anticancer agent) is administered by another mode of administration, e.g., orally.

In one embodiment, the second active agent is administered intravenously or subcutaneously and once or twice daily in an amount of from about 1 to about 1000 mg, from about 5 to about 500 mg, from about 10 to about 350 mg, or from about 50 to about 200 mg. The specific amount of the second active agent will depend on the specific agent used, the type of disease being treated and/or managed, the severity and stage of disease, and the amount of Compound 1 and any optional additional active agents concurrently administered to the patient.

One or more second active ingredients or agents can be used together with a lyophilized formulation of Compound 1 in the methods and compositions provided herein. Second active agents can be large molecules (e.g., proteins) or small molecules (e.g., synthetic inorganic, organometallic, or organic molecules).

Examples of large molecule active agents include, but are not limited to, hematopoietic growth factors, cytokines, and monoclonal and polyclonal antibodies, particularly, therapeutic antibodies to cancer antigens. Typical large molecule active agents are biological molecules, such as naturally occurring or synthetic or recombinant proteins. Proteins that are particularly useful in the methods and compositions provided herein include proteins that stimulate the survival and/or proliferation of hematopoietic precursor cells and immunologically active poietic cells in vitro or in vivo. Other useful proteins stimulate the division and differentiation of committed erythroid progenitors in cells in vitro or in vivo. Particular proteins include, but are not limited to: interleukins, such as IL-2 (including recombinant IL-II ("rIL2") and canarypox IL-2), IL-10, L-12, and IL-18; interferons, such as interferon alfa-2a, interferon alfa-2b, interferon alfa-n1, interferon alfa-n3, interferon beta-1a, and interferon gamma-I b; GM-CSF and GM-CSF; and EPO.

In certain embodiments, GM-CSF, G-CSF, SCF or EPO is administered subcutaneously during about five days in a four or six week cycle in an amount ranging from about 1 to about 750 mg/m²/day, from about 25 to about 500 mg/m²/day, from about 50 to about 250 mg/m²/day, or from about 50 to about 200 mg/m²/day. In certain embodiments, GM-CSF may be administered in an amount of from about 60 to about 500 mcg/m² intravenously over 2 hours or from about 5 to about 12 mcg/m²/day subcutaneously. In certain embodiments, G-CSF may be administered subcutaneously in an amount of about 1 mcg/kg/day initially and can be adjusted depending on rise of total granulocyte counts. The maintenance dose of G-CSF may be administered in an amount of about 300 (in smaller patients) or 480 mcg subcutaneously. In certain embodiments, EPO may be administered subcutaneously in an amount of 10,000 Unit 3 times per week.

Particular proteins that can be used in the methods and compositions include, but are not limited to: filgrastim, which is sold in the United States under the trade name Neupogen® (Amgen, Thousand Oaks, Calif.); sargramostim, which is sold in the United States under the trade name Leukine® (Immunex, Seattle, Wash.); and recombi-

nant EPO, which is sold in the United States under the trade name Epogen® (Amgen, Thousand Oaks, Calif.).

Recombinant and mutated forms of GM-CSF can be prepared as described in U.S. Pat. Nos. 5,391,485; 5,393,870; and 5,229,496; all of which are incorporated herein by reference. Recombinant and mutated forms of G-CSF can be prepared as described in U.S. Pat. Nos. 4,810,643; 4,999,291; 5,528,823; and 5,580,755; the entireties of which are incorporated herein by reference.

Also provided for use in combination with a lyophilized formulation of Compound 1 provided herein are native, naturally occurring, and recombinant proteins. Further encompassed are mutants and derivatives (e.g., modified forms) of naturally occurring proteins that exhibit, in vivo, at least some of the pharmacological activity of the proteins upon which they are based. Examples of mutants include, but are not limited to, proteins that have one or more amino acid residues that differ from the corresponding residues in the naturally occurring forms of the proteins. Also encompassed by the term "mutants" are proteins that lack carbohydrate moieties normally present in their naturally occurring forms (e.g., nonglycosylated forms). Examples of derivatives include, but are not limited to, pegylated derivatives and fusion proteins, such as proteins formed by fusing IgG1 or IgG3 to the protein or active portion of the protein of interest. See, e.g., Penichet, M. L. and Morrison, S. L., *J. Immunol. Methods* 248:91-101 (2001).

Antibodies that can be used in combination with a lyophilized formulation of Compound 1 provided herein include monoclonal and polyclonal antibodies. Examples of antibodies include, but are not limited to, trastuzumab (Herceptin®), rituximab (Rituxan®), bevacizumab (Avastin™), pertuzumab (Omnitarg™), tositumomab (Bexxar®), edrecolomab (Panorex®), and G250. The lyophilized formulation of Compound 1 can also be combined with, or used in combination with, anti-TNF- α antibodies, and/or anti-EGFR antibodies, such as, for example, Erbitux® or panitumumab.

Large molecule active agents may be administered in the form of anti-cancer vaccines. For example, vaccines that secrete, or cause the secretion of, cytokines such as IL-2, G-CSF, and GM-CSF can be used in the methods and pharmaceutical compositions provided. See, e.g., Emens, L. A., et al., *Curr. Opinion Mol. Ther.* 3(1):77-84 (2001).

Second active agents that are small molecules can also be used to alleviate adverse effects associated with the administration of a lyophilized formulation of Compound 1 provided herein. However, like some large molecules, many are believed to be capable of providing a synergistic effect when administered with (e.g., before, after or simultaneously) a lyophilized formulation of Compound 1 provided herein. Examples of small molecule second active agents include, but are not limited to, anti-cancer agents, antibiotics, immunosuppressive agents, and steroids.

In certain embodiments, the second agent is an HSP inhibitor, a proteasome inhibitor, a FLT3 inhibitor or a TOR kinase inhibitor.

Examples of anti-cancer agents to be used within the methods or compositions described herein include, but are not limited to: acivicin; aclarubicin; acodazole hydrochloride; acronine; adozelesin; aldesleukin; altretamine; ambomycin; ametantrone acetate; amsacrine; anastrozole; anthramycin; asparaginase; asperlin; azacitidine; azetepa; azotomycin; batimastat; benzodepa; bicalutamide; bisantrene hydrochloride; bisnafide dimesylate; bizelesin; bleomycin sulfate; brequinar sodium; bropiramine; busulfan; cactinomycin; calusterone; caracemide; carbetimer; carbo-

platin; carmustine; carubicin hydrochloride; carzelesin; cedefingol; celecoxib (COX-2 inhibitor); chlorambucil; cirolemycin; cisplatin; cladribine; clofarabine; crisnatol mesylate; cyclophosphamide; Ara-C; dacarbazine; dactinomycin; daunorubicin hydrochloride; decitabine; dexormaplatin; dezaguanine; dezaguanine mesylate; diaziquone; docetaxel; doxorubicin; doxorubicin hydrochloride; droloxifene; droloxifene citrate; dromostanolone propionate; duazomycin; edatrexate; efflornithine hydrochloride; elsamitracin; enloplatin; enpromate; epipropidine; epirubicin hydrochloride; erbulozole; esorubicin hydrochloride; estramustine; estramustine phosphate sodium; etanidazole; etoposide; etoposide phosphate; etoprine; fadrozole hydrochloride; fazarabine; fenretinide; floxuridine; fludarabine phosphate; fluorouracil; flurocitabine; fosquidone; fostriecin sodium; gemcitabine; gemcitabine hydrochloride; hydroxyurea; idarubicin hydrochloride; ifosfamide; ilmofofene; iproplatin; irinotecan; irinotecan hydrochloride; lanreotide acetate; letrozole; leuprolide acetate; liarozole hydrochloride; lometrexol sodium; lomustine; losoxantrone hydrochloride; masoprocol; maytansine; mechlorethamine hydrochloride; megestrol acetate; melengestrol acetate; melphalan; menogaril; mercaptopurine; methotrexate; methotrexate sodium; metoprine; meturedopa; mitindomide; mitocarcin; mitocromin; mitogillin; mitomalcin; mitomycin; mitosper; mitotane; mitoxantrone hydrochloride; mycophenolic acid; nocodazole; nogalamycin; omacetaxine; ormaplatin; oxisuran; paclitaxel; pegaspargase; peliomycin; pentamustine; peplomycin sulfate; perfosfamide; pipobroman; piposulfan; piroxantrone hydrochloride; plicamycin; plomestane; porfimer sodium; porfiromycin; prednimustine; procarbazine hydrochloride; puromycin; puromycin hydrochloride; pyrazofurin; riboprine; safingol; safingol hydrochloride; semustine; simtrazene; sorafenib; sparfosate sodium; sparsomycin; spirogermanium hydrochloride; spiromustine; spirolatin; streptonigrin; streptozocin; sulofenur; talisomycin; tecogalan sodium; taxotere; tegafur; teloxantrone hydrochloride; temoporfin; teniposide; teroxirone; testolactone; thiamiprine; thioguanine; thiotepa; tiazofurin; tirapazamine; toremifene citrate; trestolone acetate; triciribine phosphate; trimetrexate; trimetrexate glucuronate; triptorelin; tubulozole hydrochloride; uracil mustard; uredepa; vapreotide; verteporfin; vinblastine sulfate; vincristine sulfate; vindesine; vindesine sulfate; vinepidine sulfate; vinglycinatate sulfate; vinleurosine sulfate; vinorelbine tartrate; vinrosidine sulfate; vinzolidine sulfate; vorozole; zeniplatin; zinostatin; and zorubicin hydrochloride.

Other anti-cancer drugs to be included within the methods or compositions include, but are not limited to: 20-epi-1,25 dihydroxyvitamin D3; 5-ethynyluracil; abiraterone; aclarubicin; acylfulvene; adecypenol; adozelesin; aldesleukin; ALL-TK antagonists; altretamine; ambamustine; amidox; amifostine; aminolevulinic acid; amrubicin; amsacrine; anagrelide; anastrozole; andrographolide; angiogenesis inhibitors; antagonist D; antagonist G; antarelix; anti-dorsalizing morphogenetic protein-1; antiandrogen, prostatic carcinoma; antiestrogen; antineoplaston; antisense oligonucleotides; aphidicolin glycinate; apoptosis gene modulators; apoptosis regulators; apurinic acid; ara-CDP-DL-PTBA; arginine deaminase; asulacrine; atamestane; atrimustine; axinastatin 1; axinastatin 2; axinastatin 3; azasetron; azatoxin; azatyrosine; baccatin III derivatives; balanol; batimastat; BCR/ABL antagonists; benzochlorins; benzoylstauroporine; beta lactam derivatives; beta-alethine; beta-clamycin B; betulinic acid; bFGF inhibitor; bicalutamide; bisantrene; bisaziridinylspermine; bisnafide; bistratene A; bizelesin; breflate; bropirimine; budotitane; buthionine sul-

foximine; calcipotriol; calphostin C; camptothecin derivatives; capecitabine; carboxamide-amino-triazole; carboxyamidotriazole; CaRest M3; CARN 700; cartilage derived inhibitor; carzelesin; casein kinase inhibitors (ICOS); castanospermine; cecropin B; cetrerelix; chlorins; chloroquinoxaline sulfonamide; cicaprost; cis-porphyrin; cladribine; clomifene analogues; clotrimazole; collismycin A; collismycin B; combretastatin A4; combretastatin analogue; conagenin; crambescidin 816; crisnatol; cryptophycin 8; cryptophycin A derivatives; curacin A; cyclopentanethraquinones; cycloplatin; cypemycin; Ara-C ocfosfate; cytolytic factor; cytostatin; dacliximab; decitabine; dehydrididemnin B; deslorelin; dexamethasone; dexifosfamide; dexrazoxane; dexverapamil; diaziquone; didemnin B; didox; diethylmorspermine; dihydro-5-azacytidine; dihydrotaxol, 9-; dioxamycin; diphenyl spiromustine; docetaxel; docosanol; dolasetron; doxifluridine; doxorubicin; droloxifene; dronabinol; duocarmycin SA; ebelsen; ecomustine; edelfosine; edrecolomab; efflornithine; elemene; emitefur; epirubicin; epristeride; estramustine analogue; estrogen agonists; estrogen antagonists; etanidazole; etoposide phosphate; exemestane; fadrozole; fazarabine; fenretinide; filgrastim; finasteride; flavopiridol; flezelastine; fluasterone; fludarabine; fluorodaunorubicin hydrochloride; forfenimex; formestane; fostriecin; fotemustine; gadolinium texaphyrin; gallium nitrate; galocitabine; ganirelix; gelatinase inhibitors; gemcitabine; glutathione inhibitors; hepsulfam; heregulin; hexamethylene bisacetamide; hypericin; ibandronic acid; idarubicin; idoxifene; idramantone; ilmofosine; ilomastat; imatinib (e.g., Gleevec®); imiquimod; immunostimulant peptides; insulin-like growth factor-1 receptor inhibitor; interferon agonists; interferons; interleukins; iobenguane; iododoxorubicin; ipomeanol, 4-; iroplact; irsogladine; isobengazole; isohomohalicondrin B; itasetron; jaspakinozide; kahalalide F; lamellarin-N triacetate; lanreotide; leinamycin; lenograstim; lentinan sulfate; leptolstatin; letrozole; leukemia inhibiting factor; leukocyte alpha interferon; leuprolide+estrogen+progesterone; leuprorelin; levamisole; liarozole; linear polyamine analogue; lipophilic disaccharide peptide; lipophilic platinum compounds; lissoclinamide 7; lobaplatin; lombricine; lometrexol; lonidamine; losoxantrone; loxoribine; lurtotecan; lutetium texaphyrin; lysofylline; lytic peptides; maitansine; mannostatin A; marimastat; masoprocol; maspin; matrilysin inhibitors; matrix metalloproteinase inhibitors; menogaril; merbarone; meterelin; methioninase; metoclopramide; MIF inhibitor; mifepristone; miltefosine; mirimostim; mitoguazone; mitolactol; mitomycin analogues; mitonafide; mitotoxin fibroblast growth factor-saporin; mitoxantrone; mofarotene; molgramostim; Erbitux, human chorionic gonadotrophin; monophosphoryl lipid A+myobacterium cell wall sk; mopidamol; mustard anticancer agent; mycaperoxide B; mycobacterial cell wall extract; myriaporone; N-acetyldinaline; N-substituted benzamides; nafarelin; nagrestip; naloxone+pentazocine; napavin; naphterpin; nartograstim; nedaplatin; nemo-rubicin; neridronic acid; nilutamide; nisamycin; nitric oxide modulators; nitroxide antioxidant; nitrullyn; oblimersen (Genasense®); O⁶-benzylguanine; octreotide; okicenone; oligonucleotides; onapristone; ondansetron; ondansetron; oracin; oral cytokine inducer; ormaplatin; osaterone; oxalipatin; oxaunomycin; paclitaxel; paclitaxel analogues; paclitaxel derivatives; palauamine; palmitoylrhizoxin; pamidronic acid; panaxytriol; panomifene; parabactin; pazelliptine; pegaspargase; peldesine; pentosan polysulfate sodium; pentostatin; pentozole; perflubron; perfosfamide; perillyl alcohol; phenazinomycin; phenylacetate; phosphatase inhibitors; picibanil; pilocarpine hydrochloride;

pirarubicin; piritrexim; placetin A; placetin B; plasminogen activator inhibitor; platinum complex; platinum compounds; platinum-triamine complex; porfimer sodium; porfiromycin; prednisone; propyl bis-acridone; prostaglandin J2; proteasome inhibitors; protein A-based immune modulator; protein kinase C inhibitor; protein kinase C inhibitors, microalgal; protein tyrosine phosphatase inhibitors; purine nucleoside phosphorylase inhibitors; purpurins; pyrazolo-acridine; pyridoxylated hemoglobin polyoxyethylene conjugate; raf antagonists; raltitrexed; ramosetron; ras farnesyl protein transferase inhibitors; ras inhibitors; ras-GAP inhibitor; retelliptine demethylated; rhenium Re 186 etidronate; rhizoxin; ribozymes; RII retinamide; rohitukine; romurtide; roquinimex; rubiginone B1; ruboxyl; safinol; saintopin; SarCNU; sarcophytol A; sargramostim; Sdi 1 mimetics; semustine; senescence derived inhibitor 1; sense oligonucleotides; signal transduction inhibitors; sizofiran; sobuzoxane; sodium borocaptate; sodium phenylacetate; solverol; somatomedin binding protein; sonermin; sparfosic acid; spicamycin D; spiromustine; splenopentin; spongistatin 1; squalamine; stipiamide; stromelysin inhibitors; sulfinosine; superactive vasoactive intestinal peptide antagonist; suradista; suramin; swainsonine; tallimustine; tamoxifen methiodide; tauromustine; tazarotene; tecogalan sodium; tegafur; tellurapyrylium; telomerase inhibitors; temoporfin; teniposide; tetrachlorodecaoxide; tetrazomine; thaliblastine; thiocoraline; thrombopoietin; thrombopoietin mimetic; thymalfasin; thymopoietin receptor agonist; thymotrinan; thyroid stimulating hormone; tin ethyl etiopurpurin; tirapazamine; titanocene bichloride; topsentin; toremifene; translation inhibitors; tretinoin; triacetyluridine; triciribine; trimetrexate; triptorelin; tropisetron; turosteride; tyrosine kinase inhibitors; tyrphostins; UBC inhibitors; ubenimex; urogenital sinus-derived growth inhibitory factor; urokinase receptor antagonists; vapreotide; variolin B; velaresol; veramine; verdins; verteporfin; vinorelbine; vinxaltine; vitaxin; vorozole; zanoterone; zeniplatin; zilascorb; and zinostatin stimalamer.

In certain embodiments, a lyophilized formulation of Compound 1 is administered in combination with checkpoint inhibitors. In one embodiment, one checkpoint inhibitor is used in combination with a lyophilized formulation of Compound 1 in connection with the methods provided herein. In another embodiment, two checkpoint inhibitors are used in combination with a lyophilized formulation of Compound 1 in connection with the methods provided herein. In yet another embodiment, three or more checkpoint inhibitors are used in combination with a lyophilized formulation of Compound 1 in connection with the methods provided herein.

As used herein, the term “immune checkpoint inhibitor” or “checkpoint inhibitor” refers to molecules that totally or partially reduce, inhibit, interfere with or modulate one or more checkpoint proteins. Without being limited by a particular theory, checkpoint proteins regulate T-cell activation or function. Numerous checkpoint proteins are known, such as CTLA-4 and its ligands CD80 and CD86; and PD-1 with its ligands PD-L1 and PD-L2 (Pardoll, *Nature Reviews Cancer*, 2012, 12, 252-264). These proteins appear responsible for co-stimulatory or inhibitory interactions of T-cell responses. Immune checkpoint proteins appear to regulate and maintain self-tolerance and the duration and amplitude of physiological immune responses. Immune checkpoint inhibitors include antibodies or are derived from antibodies.

In one embodiment, the checkpoint inhibitor is a CTLA-4 inhibitor. In one embodiment, the CTLA-4 inhibitor is an anti-CTLA-4 antibody. Examples of anti-CTLA-4 antibod-

ies include, but are not limited to, those described in U.S. Pat. Nos. 5,811,097; 5,811,097; 5,855,887; 6,051,227; 6,207,157; 6,682,736; 6,984,720; and 7,605,238, all of which are incorporated herein in their entireties. In one embodiment, the anti-CTLA-4 antibody is tremelimumab (also known as ticilimumab or CP-675,206). In another embodiment, the anti-CTLA-4 antibody is ipilimumab (also known as MDX-010 or MDX-101). Ipilimumab is a fully human monoclonal IgG antibody that binds to CTLA-4. Ipilimumab is marketed under the trade name Yervoy™.

In one embodiment, the checkpoint inhibitor is a PD-1/PD-L1 inhibitor. Examples of PD-1/PD-L1 inhibitors include, but are not limited to, those described in U.S. Pat. Nos. 7,488,802; 7,943,743; 8,008,449; 8,168,757; 8,217,149, and PCT Patent Application Publication Nos. WO2003042402, WO2008156712, WO2010089411, WO2010036959, WO2011066342, WO2011159877, WO2011082400, and WO2011161699, all of which are incorporated herein in their entireties.

In one embodiment, the checkpoint inhibitor is a PD-1 inhibitor. In one embodiment, the PD-1 inhibitor is an anti-PD-1 antibody. In one embodiment, the anti-PD-1 antibody is nivolumab (also known as ONO-4538, BMS-936558, or MDX1106) or pembrolizumab (also known as MK-3475, SCH 900475, or lambrolizumab). In one embodiment, the anti-PD-1 antibody is nivolumab. Nivolumab is a human IgG4 anti-PD-1 monoclonal antibody, and is marketed under the trade name Opdivo™. In another embodiment, the anti-PD-1 antibody is pembrolizumab. Pembrolizumab is a humanized monoclonal IgG4 antibody and is marketed under the trade name Keytruda™. In yet another embodiment, the anti-PD-1 antibody is CT-011, a humanized antibody. CT-011 administered alone has failed to show response in treating acute myeloid leukemia (AML) at relapse. In yet another embodiment, the anti-PD-1 antibody is AMP-224, a fusion protein.

In one embodiment, the checkpoint inhibitor is a PD-L1 inhibitor. In one embodiment, the PD-L1 inhibitor is an anti-PD-L1 antibody. In one embodiment, the anti-PD-L1 antibody is MEDI4736 (durvalumab). In another embodiment, the anti-PD-L1 antibody is BMS-936559 (also known as MDX-1105-01). In yet another embodiment, the PD-L1 inhibitor is atezolizumab (also known as MPDL3280A, and Tecentriq®).

In one embodiment, the checkpoint inhibitor is a PD-L2 inhibitor. In one embodiment, the PD-L2 inhibitor is an anti-PD-L2 antibody. In one embodiment, the anti-PD-L2 antibody is rHIgM12B7A.

In one embodiment, the checkpoint inhibitor is a lymphocyte activation gene-3 (LAG-3) inhibitor. In one embodiment, the LAG-3 inhibitor is IMP321, a soluble Ig fusion protein (Brignone et al., *J. Immunol.*, 2007, 179, 4202-4211). In another embodiment, the LAG-3 inhibitor is BMS-986016.

In one embodiment, the checkpoint inhibitors is a B7 inhibitor. In one embodiment, the B7 inhibitor is a B7-H3 inhibitor or a B7-H4 inhibitor. In one embodiment, the B7-H3 inhibitor is MGA271, an anti-B7-H3 antibody (Loo et al., *Clin. Cancer Res.*, 2012, 3834).

In one embodiment, the checkpoint inhibitors is a TIM3 (T-cell immunoglobulin domain and mucin domain 3) inhibitor (Fourcade et al., *J. Exp. Med.*, 2010, 207, 2175-86; Sakuishi et al., *J. Exp. Med.*, 2010, 207, 2187-94).

In one embodiment, the checkpoint inhibitor is an OX40 (CD134) agonist. In one embodiment, the checkpoint inhibitor is an anti-OX40 antibody. In one embodiment, the

anti-OX40 antibody is anti-OX-40. In another embodiment, the anti-OX40 antibody is MEDI6469.

In one embodiment, the checkpoint inhibitor is a GITR agonist. In one embodiment, the checkpoint inhibitor is an anti-GITR antibody. In one embodiment, the anti-GITR antibody is TRX518.

In one embodiment, the checkpoint inhibitor is a CD137 agonist. In one embodiment, the checkpoint inhibitor is an anti-CD137 antibody. In one embodiment, the anti-CD137 antibody is urelumab. In another embodiment, the anti-CD137 antibody is PF-05082566.

In one embodiment, the checkpoint inhibitor is a CD40 agonist. In one embodiment, the checkpoint inhibitor is an anti-CD40 antibody. In one embodiment, the anti-CD40 antibody is CF-870,893.

In one embodiment, the checkpoint inhibitor is recombinant human interleukin-15 (rhIL-15).

In one embodiment, the checkpoint inhibitor is an IDO inhibitor. In one embodiment, the IDO inhibitor is INCB024360. In another embodiment, the IDO inhibitor is indoximod.

In certain embodiments, the combination therapies provided herein include two or more of the checkpoint inhibitors described herein (including checkpoint inhibitors of the same or different class). Moreover, the combination therapies described herein can be used in combination with second active agents as described herein where appropriate for treating diseases described herein and understood in the art.

In certain embodiments, Compound 1 can be used in combination with one or more immune cells expressing one or more chimeric antigen receptors (CARs) on their surface (e.g., a modified immune cell). Generally, CARs comprise an extracellular domain from a first protein e.g., an antigen-binding protein), a transmembrane domain, and an intracellular signaling domain. In certain embodiments, once the extracellular domain binds to a target protein such as a tumor-associated antigen (TAA) or tumor-specific antigen (TSA), a signal is generated via the intracellular signaling domain that activates the immune cell, e.g., to target and kill a cell expressing the target protein.

Extracellular domains: The extracellular domains of the CARs bind to an antigen of interest. In certain embodiments, the extracellular domain of the CAR comprises a receptor, or a portion of a receptor, that binds to said antigen. In certain embodiments, the extracellular domain comprises, or is, an antibody or an antigen-binding portion thereof. In specific embodiments, the extracellular domain comprises, or is, a single chain Fv (scFv) domain. The single-chain Fv domain can comprise, for example, a V_L linked to V_H by a flexible linker, wherein said V_L and V_H are from an antibody that binds said antigen.

In certain embodiments, the antigen recognized by the extracellular domain of a polypeptide described herein is a tumor-associated antigen (TAA) or a tumor-specific antigen (TSA). In various specific embodiments, the tumor-associated antigen or tumor-specific antigen is, without limitation, Her2, prostate stem cell antigen (PSCA), alpha-fetoprotein (AFP), carcinoembryonic antigen (CEA), cancer antigen-125 (CA-125), CA19-9, calretinin, MUC-1, B cell maturation antigen (BCMA), epithelial membrane protein (EMA), epithelial tumor antigen (ETA), tyrosinase, melanoma-24 associated antigen (MAGE), CD19, CD22, CD27, CD30, CD34, CD45, CD70, CD99, CD117, EGFRvIII (epidermal growth factor variant III), mesothelin, PAP (prostatic acid phosphatase), prostatein, TARP (T cell receptor gamma alternate reading frame protein), Trp-p8, STEAPI (six-trans-

membrane epithelial antigen of the prostate 1), chromogranin, cytokeratin, desmin, glial fibrillary acidic protein (GFAP), gross cystic disease fluid protein (GCDFP-15), HMB-45 antigen, protein melan-A (melanoma antigen recognized by T lymphocytes; MART-1), myo-D1, muscle-specific actin (MSA), neurofilament, neuron-specific enolase (NSE), placental alkaline phosphatase, synaptophysin, thyroglobulin, thyroid transcription factor-1, the dimeric form of the pyruvate kinase isoenzyme type M2 (tumor M2-PK), an abnormal ras protein, or an abnormal p53 protein. In certain other embodiments, the TAA or TSA recognized by the extracellular domain of a CAR is integrin $\alpha v \beta 3$ (CD61), galactin, or Ral-B.

In certain embodiments, the TAA or TSA recognized by the extracellular domain of a CAR is a cancer/testis (CT) antigen, e.g., BAGE, CAGE, CTAGE, FATE, GAGE, HCA661, HOM-TES-85, MAGEA, MAGEB, MAGEC, NA88, NY-ESO-1, NY-SAR-35, OY-TES-1, SPANXBI, SPA17, SSX, SYCP1, or TPTE.

In certain other embodiments, the TAA or TSA recognized by the extracellular domain of a CAR is a carbohydrate or ganglioside, e.g., fuc-GMI, GM2 (oncofetal antigen-immunogenic-1; OFA-I-1); GD2 (OFA-I-2), GM3, GD3, and the like.

In certain other embodiments, the TAA or TSA recognized by the extracellular domain of a CAR is alpha-actinin-4, Bage-1, BCR-ABL, Bcr-Abl fusion protein, beta-catenin, CA 125, CA 15-3 (CA 27.29\BCAA), CA 195, CA 242, CA-50, CAM43, Casp-8, cdc27, cdk4, cdkn2a, CEA, coa-1, dek-can fusion protein, EBNA, EF2, Epstein Barr virus antigens, ETV6-AML1 fusion protein, HLA-A2, HLA-A11, hsp70-2, KIAA0205, Mart2, Mum-1, 2, and 3, neo-PAP, myosin class I, OS-9, pm1-RAR α fusion protein, PTPRK, K-ras, N-ras, triosephosphate isomerase, Gage 3, 4, 5, 6, 7, GnTV, Herv-K-mel, Lage-1, NA-88, NY-Eso-1/Lage-2, SP17, SSX-2, TRP2-Int2, gp100 (Pme117), tyrosinase, TRP-1, TRP-2, MAGE-1, MAGE-3, RAGE, GAGE-1, GAGE-2, p15(58), RAGE, SCP-1, Hom/Me1-40, PRAME, p53, HRas, HER-2/neu, E2A-PRL, H4-RET, IGH-IGK, MYL-RAR, human papillomavirus (HPV) antigens E6 and E7, TSP-180, MAGE-4, MAGE-5, MAGE-6, p185erbB2, p180erbB-3, c-met, nm-23H1, PSA, TAG-72-4, CA 19-9, CA 72-4, CAM 17.1, NuMa, K-ras, 13-Catenin, Mum-1, p16, TAGE, PSMA, CT7, telomerase, 43-9F, 5T4, 791Tgp72, 13HCG, BCA225, BTAA, CD68\KP1, C0-029, FGF-5, G250, Ga733 (EpCAM), HTgp-175, M344, MA-50, MG7-Ag, MOV18, NB70K, NY-C0-1, RCAS1, SDC-CAG16, TA-90, TAAL6, TAG72, TLP, or TPS.

In various specific embodiments, the tumor-associated antigen or tumor-specific antigen is an AML-related tumor antigens, as described in S. Anguille et al, *Leukemia* (2012), 26, 2186-2196.

Other tumor-associated and tumor-specific antigens are known to those in the art.

Receptors, antibodies, and scFvs that bind to TSAs and TAAs, useful in constructing chimeric antigen receptors, are known in the art, as are nucleotide sequences that encode them.

In certain specific embodiments, the antigen recognized by the extracellular domain of a chimeric antigen receptor is an antigen not generally considered to be a TSA or a TAA, but which is nevertheless associated with tumor cells, or damage caused by a tumor. In certain embodiments, for example, the antigen is, e.g., a growth factor, cytokine or interleukin, e.g., a growth factor, cytokine, or interleukin associated with angiogenesis or vasculogenesis. Such growth factors, cytokines, or interleukins can include, e.g.,

vascular endothelial growth factor (VEGF), basic fibroblast growth factor (bFGF), platelet-derived growth factor (PDGF), hepatocyte growth factor (HGF), insulin-like growth factor (IGF), or interleukin-8 (IL-8). Tumors can also create a hypoxic environment local to the tumor. As such, in other specific embodiments, the antigen is a hypoxia-associated factor, e.g., HIF-1 α , HIF-1 β , HIF-2 α , HIF-2 β , HIF-3 α , or HIF-3 β . Tumors can also cause localized damage to normal tissue, causing the release of molecules known as damage associated molecular pattern molecules (DAMPs; also known as alarmins). In certain other specific embodiments, therefore, the antigen is a DAMP, e.g., a heat shock protein, chromatin-associated protein high mobility group box 1 (HMGB 1), S100A8 (MRP8, calgranulin A), S100A9 (MRP14, calgranulin B), serum amyloid A (SAA), or can be a deoxyribonucleic acid, adenosine triphosphate, uric acid, or heparin sulfate.

Transmembrane domain: In certain embodiments, the extracellular domain of the CAR is joined to the transmembrane domain of the polypeptide by a linker, spacer or hinge polypeptide sequence, e.g., a sequence from CD28 or a sequence from CTLA4. The transmembrane domain can be obtained or derived from the transmembrane domain of any transmembrane protein, and can include all or a portion of such transmembrane domain. In specific embodiments, the transmembrane domain can be obtained or derived from, e.g., CD8, CD16, a cytokine receptor, and interleukin receptor, or a growth factor receptor, or the like.

Intracellular signaling domains: In certain embodiments, the intracellular domain of a CAR is or comprises an intracellular domain or motif of a protein that is expressed on the surface of T cells and triggers activation and/or proliferation of said T cells. Such a domain or motif is able to transmit a primary antigen-binding signal that is necessary for the activation of a T lymphocyte in response to the antigen's binding to the CAR's extracellular portion. Typically, this domain or motif comprises, or is, an ITAM (immunoreceptor tyrosine-based activation motif). ITAM-containing polypeptides suitable for CARs include, for example, the zeta CD3 chain (CD3 ζ) or ITAM-containing portions thereof. In a specific embodiment, the intracellular domain is a CD3 ζ intracellular signaling domain. In other specific embodiments, the intracellular domain is from a lymphocyte receptor chain, a TCR/CD3 complex protein, an Fe receptor subunit or an IL-2 receptor subunit. In certain embodiments, the CAR additionally comprises one or more co-stimulatory domains or motifs, e.g., as part of the intracellular domain of the polypeptide. The one or more co-stimulatory domains or motifs can be, or can comprise one or more of a co-stimulatory CD27 polypeptide sequence, a co-stimulatory CD28 polypeptide sequence, a co-stimulatory OX40 (CD134) polypeptide sequence, a co-stimulatory 4-1BB (CD137) polypeptide sequence, or a co-stimulatory inducible T-cell costimulatory (ICOS) polypeptide sequence, or other costimulatory domain or motif, or any combination thereof.

The CAR may also comprise a T cell survival motif. The T cell survival motif can be any polypeptide sequence or motif that facilitates the survival of the T lymphocyte after stimulation by an antigen. In certain embodiments, the T cell survival motif is, or is derived from, CD3, CD28, an intracellular signaling domain of IL-7 receptor (IL-7R), an intracellular signaling domain of IL-12 receptor, an intracellular signaling domain of IL-15 receptor, an intracellular signaling domain of IL-21 receptor, or an intracellular signaling domain of transforming growth factor β (TGF β) receptor.

The modified immune cells expressing the CARs can be, e.g., T lymphocytes (T cells, e.g., CD4+ T cells or CD8+ T cells), cytotoxic lymphocytes (CTLs) or natural killer (NK) cells. T lymphocytes used in the compositions and methods provided herein may be naive T lymphocytes or MHC-restricted T lymphocytes. In certain embodiments, the T lymphocytes are tumor infiltrating lymphocytes (TILs). In certain embodiments, the T lymphocytes have been isolated from a tumor biopsy, or have been expanded from T lymphocytes isolated from a tumor biopsy. In certain other embodiments, the T cells have been isolated from, or are expanded from T lymphocytes isolated from, peripheral blood, cord blood, or lymph. Immune cells to be used to generate modified immune cells expressing a CAR can be isolated using art-accepted, routine methods, e.g., blood collection followed by apheresis and optionally antibody-mediated cell isolation or sorting.

The modified immune cells are preferably autologous to an individual to whom the modified immune cells are to be administered. In certain other embodiments, the modified immune cells are allogeneic to an individual to whom the modified immune cells are to be administered. Where allogeneic T lymphocytes or NK cells are used to prepare modified T lymphocytes, it is preferable to select T lymphocytes or NK cells that will reduce the possibility of graft-versus-host disease (GVHD) in the individual. For example, in certain embodiments, virus-specific T lymphocytes are selected for preparation of modified T lymphocytes; such lymphocytes will be expected to have a greatly reduced native capacity to bind to, and thus become activated by, any recipient antigens. In certain embodiments, recipient-mediated rejection of allogeneic T lymphocytes can be reduced by co-administration to the host of one or more immunosuppressive agents, e.g., cyclosporine, tacrolimus, sirolimus, cyclophosphamide, or the like.

T lymphocytes, e.g., unmodified T lymphocytes, or T lymphocytes expressing CD3 and CD28, or comprising a polypeptide comprising a CD3 ζ signaling domain and a CD28 co-stimulatory domain, can be expanded using antibodies to CD3 and CD28, e.g., antibodies attached to beads; see, e.g., U.S. Pat. Nos. 5,948,893; 6,534,055; 6,352,694; 6,692,964; 6,887,466; and 6,905,681.

The modified immune cells, e.g., modified T lymphocytes, can optionally comprise a "suicide gene" or "safety switch" that enables killing of substantially all of the modified immune cells when desired. For example, the modified T lymphocytes, in certain embodiments, can comprise an HSV thymidine kinase gene (HSV-TK), which causes death of the modified T lymphocytes upon contact with gancyclovir. In another embodiment, the modified T lymphocytes comprise an inducible caspase, e.g., an inducible caspase 9 (icaspase9), e.g., a fusion protein between caspase 9 and human FK506 binding protein allowing for dimerization using a specific small molecule pharmaceutical. See Straathof et al., *Blood* 105(11):4247-4254 (2005).

Specific second active agents particularly useful in the methods or compositions include, but are not limited to, rituximab, oblimersen (Genasense®), remicade, docetaxel, celecoxib, melphalan, dexamethasone (Decadron®), steroids, gemcitabine, cisplatin, temozolomide, etoposide, cyclophosphamide, temodar, carboplatin, procarbazine, gliadel, tamoxifen, topotecan, methotrexate, Arisa®, taxol, taxotere, fluorouracil, leucovorin, irinotecan, xeloda, interferon alpha, pegylated interferon alpha (e.g., PEG INTRON-A), capecitabine, cisplatin, thiotepa, fludarabine, carboplatin, liposomal daunorubicin, Ara-C, doxorubicin, paclitaxel, vinblastine, IL-2, GM-CSF, dacarbazine, vinorelbine, zole-

dronic acid, palmitronate, biacin, busulphan, prednisone, bisphosphonate, arsenic trioxide, vincristine, doxorubicin (Doxil®), paclitaxel, ganciclovir, adriamycin, estramustine sodium phosphate (Emcyt®), sulindac, and etoposide.

In certain embodiments of the methods provided herein, use of a second active agent in combination with a lyophilized formulation of Compound 1 provided herein may be modified or delayed during or shortly following administration of a lyophilized formulation of Compound 1 provided herein as deemed appropriate by the practitioner of skill in the art. In certain embodiments, subjects being administered a lyophilized formulation of Compound 1 provided herein alone or in combination with other therapies may receive supportive care including antiemetics, myeloid growth factors, and transfusions of platelets, when appropriate. In some embodiments, subjects being administered a lyophilized formulation of Compound 1 provided herein may be administered a growth factor as a second active agent according to the judgment of the practitioner of skill in the art. In some embodiments, provided is administration of a lyophilized formulation of Compound 1 provided herein in combination with erythropoietin or darbepoetin (Aranesp).

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered with gemcitabine, cisplatin, 5-fluorouracil, mitomycin, methotrexate, vinblastine, doxorubicin, carboplatin, thiopeta, paclitaxel or docetaxel to patients with locally advanced or metastatic transitional cell bladder cancer.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered in combination with a second active ingredient as follows: temozolomide to pediatric patients with relapsed or progressive brain tumors or recurrent neuroblastoma; celecoxib, etoposide and cyclophosphamide for relapsed or progressive CNS cancer; temodar to patients with recurrent or progressive meningioma, malignant meningioma, hemangiopericytoma, multiple brain metastases, relapsed brain tumors, or newly diagnosed glioblastoma multiformis; irinotecan to patients with recurrent glioblastoma; carboplatin to pediatric patients with brain stem glioma; procarbazine to pediatric patients with progressive malignant gliomas; cyclophosphamide to patients with poor prognosis malignant brain tumors, newly diagnosed or recurrent glioblastoma multiformis; Gliadel® for high grade recurrent malignant gliomas; temozolomide and tamoxifen for anaplastic astrocytoma; or topotecan for gliomas, glioblastoma, anaplastic astrocytoma or anaplastic oligodendroglioma.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered with methotrexate, cyclophosphamide, 5-fluorouracil, taxane, everolimus, abraxane, lapatinib, herceptin, pamidronate disodium, eribulin mesylate, everolimus, gemcitabine, palbociclib, ixabepilone, kadcyla, pertuzumab, theotepa, aromatase inhibitors, exemestane, selective estrogen modulators, estrogen receptor antagonists, anthracyclines, emtansine, and/or pexidartinib to patients with metastatic breast cancer.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered with temozolomide, doxorubicin (Adriamycin), fluorouracil (Acrucil, 5-fluorouracil), or streptozocin (Zanosar) to patients with neuroendocrine tumors.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered with methotrexate, gemcitabine, cisplatin, cetuximab, 5-fluorouracil, bleomycin, docetaxel or carboplatin to patients with recurrent or metastatic head or neck cancer.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered with gemcitabine, abraxane, 5-fluorouracil, afinitor, irinotecan, mitomycin C, sunitinib or tarceva to patients with pancreatic cancer.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered to patients with colon cancer in combination with ARISA®, avastatin, oxaliplatin, 5-fluorouracil, irinotecan, capecitabine, cetuximab, ramucirumab, panitumumab, bevacizumab, leucovorin calcium, lonsurf, regorafenib, ziv-aflibercept, taxol, and/or taxotere.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered with capecitabine and/or vemurafenib to patients with refractory colorectal cancer or patients who fail first line therapy or have poor performance in colon or rectal adenocarcinoma.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered in combination with fluorouracil, leucovorin, and irinotecan to patients with Dukes C & D colorectal cancer or to patients who have been previously treated for metastatic colorectal cancer.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered to patients with refractory colorectal cancer in combination with capecitabine, xeloda, and/or irinotecan.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered with capecitabine and irinotecan to patients with refractory colorectal cancer or to patients with unresectable or metastatic colorectal carcinoma.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered alone or in combination with interferon alpha or capecitabine to patients with unresectable or metastatic hepatocellular carcinoma; or with cisplatin and thiopeta, or with sorafenib tosylate to patients with primary or metastatic liver cancer.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered in combination with doxorubicin, paclitaxel, vinblastine or pegylated interferon alpha to patients with Kaposi's sarcoma.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered in combination with arsenic trioxide, fludarabine, carboplatin, daunorubicin, cyclophosphamide, cytarabine, doxorubicin, idarubicin, mitoxantrone hydrochloride, thioguanine, vincristine, and/or topotecan to patients with acute myeloid leukemia, including refractory or relapsed or high-risk acute myeloid leukemia.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered in combination with liposomal daunorubicin, topotecan and/or cytarabine to patients with unfavorable karyotype acute myeloblastic leukemia.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered in combination with methotrexate, mechlorethamine hydrochloride, afatinib dimaleate, pemetrexed, bevacizumab, carboplatin, cisplatin, ceritinib, crizotinib, ramucirumab, pembrolizumab, docetaxel, vinorelbine tartrate, gemcitabine, abraxane, erlotinib, gefitinib, and/or irinotecan to patients with non-small cell lung cancer.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered in combination with carboplatin and irinotecan to patients with non-small cell lung cancer.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered with doxorubicin

to patients with non-small cell lung cancer who have been previously treated with carbo/etoposide and radiotherapy.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered in combination with carboplatin and/or taxotere, or in combination with carboplatin, paclitaxel and/or thoracic radiotherapy to patients with non-small cell lung cancer.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered in combination with taxotere to patients with stage IIIB or IV non-small cell lung cancer.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered in combination with oblimersen (Genasense®), methotrexate, mechlorethamine hydrochloride, etoposide, topotecan or doxorubicin to patients with small cell lung cancer.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered in combination with ABT-737 (Abbott Laboratories) and/or obatoclax (GX15-070) to patients with lymphoma and other blood cancers.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered alone or in combination with a second active ingredient such as vinblastine or fludarabine adcetris, ambochlorin, becenun, bleomycin, brentuximab vedotin, carmustine chlorambucil, cyclophosphamide, dacarbazine, doxorubicin, lomustine, matulane, mechlorethamine hydrochloride, prednisone, procarbazine hydrochloride or vincristine to patients with various types of lymphoma, including, but not limited to, Hodgkin's lymphoma, non-Hodgkin's lymphoma, cutaneous T-Cell lymphoma, cutaneous B-Cell lymphoma, diffuse large B-Cell lymphoma or relapsed or refractory low grade follicular lymphoma.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered in combination with taxotere, dabrafenib, imlygic, ipilimumab, pembrolizumab, nivolumab, trametinib, vemurafenib, talimogene laherparepvec, IL-2, IFN, GM-CSF, and/or dacarbazine to patients with various types or stages of melanoma.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered alone or in combination with vinorelbine to patients with malignant mesothelioma, or stage IIIB non-small cell lung cancer with pleural implants or malignant pleural effusion mesothelioma syndrome.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered to patients with various types or stages of multiple myeloma in combination with dexamethasone, zoledronic acid, palmitronate, GM-CSF, biacin, vinblastine, melphalan, busulphan, cyclophosphamide, IFN, prednisone, bisphosphonate, celecoxib, arsenic trioxide, PEG INTRON-A, vincristine, becenun, bortezomib, carfilzomib, doxorubicin, panobinostat, lenalidomide, pomalidomide, thalidomide, mozobil or a combination thereof.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered to patients with various types or stages of multiple myeloma in combination with chimeric antigen receptor (CAR) T-cells.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered to patients with relapsed or refractory multiple myeloma in combination with doxorubicin (Doxil®), vincristine and/or dexamethasone (Decadron®).

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered to patients with various types or stages of ovarian cancer such as peritoneal carcinoma, papillary serous carcinoma, refractory ovarian cancer or recurrent ovarian cancer, in combination with taxol, carboplatin, doxorubicin, gemcitabine, cisplatin, xeloda, paclitaxel, dexamethasone, avastin, cyclophosphamide, topotecan, olaparib, thiotepa, or a combination thereof.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered to patients with various types or stages of prostate cancer, in combination with xeloda, 5 FU/LV, gemcitabine, irinotecan plus gemcitabine, cyclophosphamide, vincristine, dexamethasone, GM-CSF, celecoxib, taxotere, ganciclovir, paclitaxel, adriamycin, docetaxel, estramustine, Emcyt, denderon, zytiga, bicalutamide, cabazitaxel, degarelix, enzalutamide, zoladex, leuprolide acetate, mitoxantrone hydrochloride, prednisone, sipuleucel-T, radium 223 dichloride, or a combination thereof.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered to patients with various types or stages of renal cell cancer, in combination with capecitabine, IFN, tamoxifen, IL-2, GM-CSF, Celebrex®, or a combination thereof.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered to patients with various types or stages of gynecologic, uterus or soft tissue sarcoma cancer in combination with IFN, dactinomycin, doxorubicin, imatinib mesylate, pazopanib, hydrochloride, trabectedin, a COX-2 inhibitor such as Celebrex®, and/or sulindac.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered to patients with various types or stages of solid tumors in combination with celebrex, etoposide, cyclophosphamide, docetaxel, apicitabine, IFN, tamoxifen, IL-2, GM-CSF, or a combination thereof.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered to patients with scleroderma or cutaneous vasculitis in combination with celebrex, etoposide, cyclophosphamide, docetaxel, apicitabine, IFN, tamoxifen, IL-2, GM-CSF, or a combination thereof.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered to patients with MDS in combination with azacitidine, cytarabine, daunorubicin, decitabine, idarubicin, lenalidomide or a combination thereof.

Also encompassed herein is a method of increasing the dosage of an anti-cancer drug or agent that can be safely and effectively administered to a patient, which comprises administering to the patient (e.g., a human) a lyophilized formulation of Compound 1 provided herein. Patients that can benefit by this method are those likely to suffer from an adverse effect associated with anti-cancer drugs for treating a specific cancer of the skin, subcutaneous tissue, lymph nodes, brain, lung, liver, bone, intestine, colon, heart, pancreas, adrenal, kidney, prostate, breast, colorectal, or combinations thereof. The administration of a lyophilized formulation of Compound 1 provided herein alleviates or reduces adverse effects which are of such severity that it would otherwise limit the amount of anti-cancer drug.

In one embodiment, a lyophilized formulation of Compound 1 provided herein is administered daily in an amount ranging from about 0.1 to about 150 mg, from about 1 to about 50 mg, from about 2 to about 25 mg, or from about 1

to about 10 mg prior to, during, or after the occurrence of the adverse effect associated with the administration of an anti-cancer drug to a patient. In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered in combination with specific agents such as heparin, aspirin, coumadin, or G-CSF to avoid adverse effects that are associated with anti-cancer drugs such as but not limited to neutropenia or thrombocytopenia.

In one embodiment, a lyophilized formulation of Compound 1 provided herein is administered to patients with diseases and disorders associated with or characterized by, undesired angiogenesis in combination with additional active ingredients, including, but not limited to, anti-cancer drugs, anti-inflammatories, antihistamines, antibiotics, and steroids.

In another embodiment, encompassed herein is a method of treating, preventing and/or managing cancer, which comprises administering a lyophilized formulation of Compound 1 provided herein in conjunction with (e.g. before, during, or after) conventional therapy including, but not limited to, surgery, immunotherapy, biological therapy, radiation therapy, or other non-drug based therapy presently used to treat, prevent and/or manage cancer. The combined use of the compound provided herein and conventional therapy may provide a unique treatment regimen that is unexpectedly effective in certain patients. Without being limited by theory, it is believed that a lyophilized formulation of Compound 1 provided herein may provide additive or synergistic effects when given concurrently with conventional therapy.

As discussed elsewhere herein, encompassed herein is a method of reducing, treating and/or preventing adverse or undesired effects associated with conventional therapy including, but not limited to, surgery, chemotherapy, radiation therapy, hormonal therapy, biological therapy and immunotherapy. A lyophilized formulation of Compound 1 provided herein and other active ingredient can be administered to a patient prior to, during, or after the occurrence of the adverse effect associated with conventional therapy.

In certain embodiments, the methods provided herein comprise administration of calcium, calcitriol, and vitamin D supplementation with a lyophilized formulation of Compound 1. In certain embodiments, the methods provided herein comprise administration of calcium, calcitriol, and vitamin D supplementation prior to the treatment with a lyophilized formulation of Compound 1.

In certain embodiments, calcium supplementation is administered to deliver at least 1200 mg of elemental calcium per day given in divided doses. In certain embodiments, calcium supplementation is administered as calcium carbonate in a dose of 500 mg administered three times a day per orally (PO).

In certain embodiments, calcitriol supplementation is administered to deliver 0.25 g calcitriol (PO) once daily.

In certain embodiments, vitamin D supplementation is administered to deliver about 500 IU to about 5000 IU vitamin D once daily. In certain embodiments, vitamin D supplementation is administered to deliver about 1000 IU vitamin D once daily. In certain embodiments, vitamin D supplementation is administered to deliver about 50,000 IU vitamin D weekly. In certain embodiments, vitamin D supplementation is administered to deliver about 1000 IU vitamin D2 or D3 once daily. In certain embodiments, vitamin D supplementation is administered to deliver about 50,000 IU vitamin D2 or D3 weekly.

In certain embodiments, a lyophilized formulation of Compound 1 provided herein and doxorubicin are adminis-

tered to patients with non-small cell lung cancer who were previously treated with carbo/VP 16 and radiotherapy.

6.6.2 Use with Transplantation Therapy

The lyophilized formulation of Compound 1 provided herein provided herein can be used to reduce the risk of Graft Versus Host Disease (GVHD). Therefore, encompassed herein is a method of treating, preventing and/or managing cancer, which comprises administering a lyophilized formulation of Compound 1 provided herein in conjunction with transplantation therapy.

As those of ordinary skill in the art are aware, the treatment of cancer is often based on the stages and mechanism of the disease. For example, as inevitable leukemic transformation develops in certain stages of cancer, transplantation of peripheral blood stem cells, hematopoietic stem cell preparation or bone marrow may be necessary. The combined use of a lyophilized formulation of Compound 1 provided herein provided herein and transplantation therapy provides a unique and unexpected synergism. In particular, a lyophilized formulation of Compound 1 provided herein exhibits immunomodulatory activity that may provide additive or synergistic effects when given concurrently with transplantation therapy in patients with cancer.

The lyophilized formulation of Compound 1 provided herein can work in combination with transplantation therapy reducing complications associated with the invasive procedure of transplantation and risk of GVHD. Encompassed herein is a method of treating, preventing and/or managing cancer which comprises administering to a patient (e.g., a human) lyophilized formulation of Compound 1 provided herein before, during, or after the transplantation of umbilical cord blood, placental blood, peripheral blood stem cell, hematopoietic stem cell preparation, or bone marrow. Some examples of stem cells suitable for use in the methods provided herein are disclosed in U.S. Pat. No. 7,498,171, the disclosure of which is incorporated herein by reference in its entirety.

In one embodiment, a lyophilized formulation of Compound 1 provided herein is administered to patients with acute myeloid leukemia before, during, or after transplantation.

In one embodiment, a lyophilized formulation of Compound 1 provided herein is administered to patients with multiple myeloma before, during, or after the transplantation of autologous peripheral blood progenitor cell.

In one embodiment, a lyophilized formulation of Compound 1 provided herein is administered to patients with NHL (e.g., DLBCL) before, during, or after the transplantation of autologous peripheral blood progenitor cell.

6.6.3 Cycling Therapy

In certain embodiments, the prophylactic or therapeutic agents provided herein are cyclically administered to a patient. Cycling therapy involves the administration of an active agent for a period of time, followed by a rest for a period of time, and repeating this sequential administration. Cycling therapy can reduce the development of resistance to one or more of the therapies, avoid, or reduce the side effects of one of the therapies, and/or improves the efficacy of the treatment.

Consequently, in certain embodiments, a lyophilized formulation of Compound 1 provided herein provided herein is administered daily in a single or divided dose in a four to six week cycle with a rest period of about a week or two weeks. In certain embodiments, a lyophilized formulation of Compound 1 provided herein provided herein is administered daily in a single or divided doses for one to ten consecutive days of a 28 day cycle, then a rest period with no adminis-

istration for rest of the 28 day cycle. The cycling method further allows the frequency, number, and length of dosing cycles to be increased. Thus, encompassed herein in certain embodiments is the administration of a lyophilized formulation of Compound 1 provided herein for more cycles than are typical when it is administered alone. In certain embodiments, a lyophilized formulation of Compound 1 provided herein is administered for a greater number of cycles that would typically cause dose-limiting toxicity in a patient to whom a second active ingredient is not also being administered.

In one embodiment, a lyophilized formulation of Compound 1 provided herein is administered daily and continuously for three or four weeks at a dose of from about 0.1 to about 150 mg/d followed by a break of one or two weeks.

In another embodiment, a lyophilized formulation of Compound 1 provided herein is administered intravenously and a second active ingredient is administered orally, with administration of the lyophilized formulation of Compound 1 occurring 30 to 60 minutes prior to a second active ingredient, during a cycle of four to six weeks. In certain embodiments, the combination of a lyophilized formulation of Compound 1 provided herein and a second active ingredient is administered by intravenous infusion over about 90 minutes every cycle. In certain embodiments, one cycle comprises the administration from about 0.1 to about 150 mg/day of a lyophilized formulation of Compound 1 provided herein and from about 50 to about 200 mg/m²/day of a second active ingredient daily for three to four weeks and then one or two weeks of rest. In certain embodiments, the number of cycles during which the combinatorial treatment is administered to a patient is ranging from about one to about 24 cycles, from about two to about 16 cycles, or from about four to about three cycles.

6.6.4 Patient Population

In certain embodiments of the methods provided herein, the subject is an animal, preferably a mammal, more preferably a non-human primate. In particular embodiments, the subject is a human. The subject can be a male or female subject.

Particularly useful subjects for the methods provided herein include human cancer patients, for example, those who have been diagnosed with leukemia, including acute myeloid leukemia, acute lymphocytic leukemia, chronic myelogenous leukemia, and chronic myelogenous leukemia. In certain embodiments, the subject has not been diagnosed with acute promyelocytic leukemia.

In some embodiments, the subject has a higher than normal blast population. In some embodiments, the subject has a blast population of at least 10%. In some embodiments, the subject has a blast population of between 10 and 15%. In some embodiments, the subject has a blast population of at least 15%. In some embodiments, the subject has a blast population of between 15 and 20%. In some embodiments, the subject has a blast population of at least 20%. In some embodiments, the subject has a blast population of about 10-15%, about 15-20%, or about 20-25%. In other embodiments, the subject has a blast population of less than 10%. In the context of the methods described herein, useful subjects having a blast population of less than 10% includes those subjects that, for any reason according to the judgment of the skilled practitioner in the art, are in need of treatment with a compound provided herein, alone or in combination with a second active agent.

In some embodiments, the subject is treated based on the Eastern Cooperative Oncology Group (ECOG) performance status score of the subject for leukemia. ECOG performance

status can be scored on a scale of 0 to 5, with 0 denoting asymptomatic; 1 denoting symptomatic but completely ambulant; 2 denoting symptomatic and <50% in bed during the day; 3 denoting symptomatic and >50% in bed, but not bed bound; 4 denoting bed bound; and 5 denoting death. In some embodiments, the subject has an ECOG performance status score of 0 or 1. In some embodiments, the subject has an ECOG performance status score of 0. In some embodiments, the subject has an ECOG performance status score of 1. In other embodiments, the subject has an ECOG performance status score of 2.

In certain embodiments, the methods provided herein encompass the treatment of subjects who have not been previously treated for leukemia. In some embodiments, the subject has not undergone allogeneic bone marrow transplantation. In some embodiments, the subject has not undergone a stem cell transplantation. In some embodiments, the subject has not received hydroxyurea treatment. In some embodiments, the subject has not been treated with any investigational products for leukemia. In some embodiments, the subject has not been treated with systemic glucocorticoids.

In other embodiments, the methods encompass treating subjects who have been previously treated or are currently being treated for leukemia. For example, the subject may have been previously treated or are currently being treated with a standard treatment regimen for leukemia. The subject may have been treated with any standard leukemia treatment regimen known to the practitioner of skill in the art. In certain embodiments, the subject has been previously treated with at least one induction/reinduction or consolidation AML regimen. In some embodiments, the subject has undergone autologous bone marrow transplantation or stem cell transplantation as part of a consolidation regimen. In some embodiments, the bone marrow or stem cell transplantation occurred at least 3 months prior to treatment according to the methods provided herein. In some embodiments, the subject has undergone hydroxyurea treatment. In some embodiments, the hydroxyurea treatment occurred no later than 24 hours prior to treatment according to the methods provided herein. In some embodiments, the subject has undergone prior induction or consolidation therapy with cytarabine (Ara-C). In some embodiments, the subject has undergone treatment with systemic glucocorticosteroids. In some embodiments, the glucocorticosteroid treatment occurred no later than 24 hours prior to treatment according to the methods described herein. In other embodiments, the methods encompass treating subjects who have been previously treated for cancer, but are non-responsive to standard therapies.

Also encompassed are methods of treating subjects having relapsed or refractory leukemia. In some embodiments, the subject has been diagnosed with a relapsed or refractory AML subtype, as defined by the World Health Organization (WHO). Relapsed or refractory disease may be de novo AML or secondary AML, e.g., therapy-related AML (t-AML).

In some embodiments, the methods provided herein are used to treat drug resistant leukemias, such as chronic myelogenous leukemia (CML). Thus, treatment with a compound provided herein could provide an alternative for patients who do not respond to other methods of treatment. In some embodiments, such other methods of treatment encompass treatment with Gleevec® (imatinib mesylate). In some embodiments, provided herein are methods of treatment of Philadelphia chromosome positive chronic myelogenous leukemia (Ph+CML). In some embodiments, pro-

vided herein are methods of treatment of Gleevec® (imatinib mesylate) resistant Philadelphia chromosome positive chronic myelogenous leukemia (Ph+CML).

Also encompassed are methods of treating a subject regardless of the subject's age, although some diseases or disorders are more common in certain age groups. In some embodiments, the subject is at least 18 years old. In some embodiments, the subject is more than 18, 25, 35, 40, 45, 50, 55, 60, 65, or 70 years old. In other embodiments, the subject is less than 65 years old. In some embodiments, the subject is less than 18 years old. In some embodiments, the subject is less than 18, 15, 12, 10, 9, 8 or 7 years old.

In some embodiments, the methods may find use in subjects at least 50 years of age, although younger subjects could benefit from the method as well. In other embodiments, the subjects are at least 55, at least 60, at least 65, and at least 70 years of age. In another embodiment, the subjects have adverse cytogenetics. "Adverse cytogenetics" is defined as any nondiploid karyotype, or greater than or equal to 3 chromosomal abnormalities. In another embodiment, the subjects are at least 60 years of age and have adverse cytogenetics. In another embodiment, the subjects are 60-65 years of age and have adverse cytogenetics. In another embodiment, the subjects are 65-70 years of age and have adverse cytogenetics.

In certain embodiments, the subject treated has no history of myocardial infarction within three months of treatment according to the methods provided herein. In some embodiments, the subject has no history of cerebrovascular accident or transient ischemic attack within three months of treatment according to the methods provided herein. In some embodiments, the subject has no suffered no thromboembolic event, including deep vein thrombosis or pulmonary embolus, within 28 days of treatment according to the methods provided herein. In other embodiments, the subject has not experienced or is not experiencing uncontrolled disseminated intravascular coagulation.

Because subjects with cancer have heterogeneous clinical manifestations and varying clinical outcomes, the treatment given to a patient may vary, depending on his/her prognosis. The skilled clinician will be able to readily determine without undue experimentation specific secondary agents, types of surgery, and types of non-drug based standard therapy that can be effectively used to treat an individual subject with cancer.

It will be appreciated that every suitable combination of the compounds provided herein with one or more of the aforementioned compounds and optionally one or more further pharmacologically active substances is contemplated herein.

6.7 Evaluation of Activity

Standard physiological, pharmacological and biochemical procedures are available for testing the compounds to identify those that possess the desired anti-proliferative activity.

Such assays include, for example, biochemical assays such as binding assays, radioactivity incorporation assays, as well as a variety of cell based assays, including KG-1 cell proliferation assay described in the Example section.

Embodiments provided herein may be more fully understood by reference to the following examples. These examples are meant to be illustrative of pharmaceutical compositions and dosage forms provided herein, but are not in any way limiting.

7. EXAMPLES

The following Examples are presented by way of illustration, not limitation. The following abbreviations are used in descriptions and examples.

SWFI—Sterile Water for Injection

WFI—Water for injection

D5W—Dextrose 5% in Water

HPβCD—Hydroxypropyl-beta-cyclodextrin

SBEβCD—Sulfobutylether-β-cyclodextrin sodium salt

TBA—Tert-butyl alcohol

DMA—Dimethylacetamide

HAS—Human serum albumin

FDM—Freeze-drying microscope

SEM—Scanning electron microscope

LT-DSC—Low temperature differential scanning calorimetry

DSC—Differential scanning calorimetry

DVS Dynamic vapor sorption

TGA—Thermogravimetric analysis

GC—Gas chromatography

KF—Karl Fisher

"Compound 1, Form C" or "Form C" or "API" in the Examples herein refers to polymorph Form C of 2-(4-Chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide. "Compound 1, Form A" or "Form A" in the Examples herein refers to polymorph Form A of 2-(4-Chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide. The physical and chemical properties of 2-(4-Chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide are summarized in Table 1.

TABLE 1

Summary of physical and chemical properties of 2-(4-Chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide

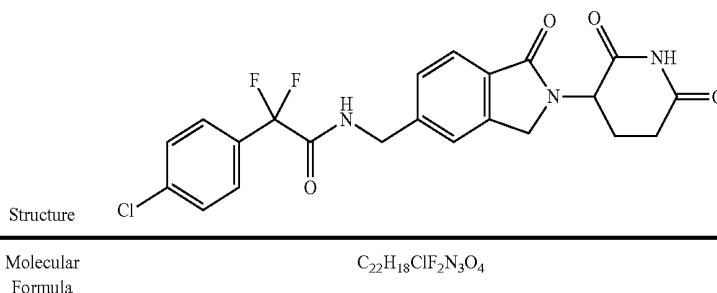
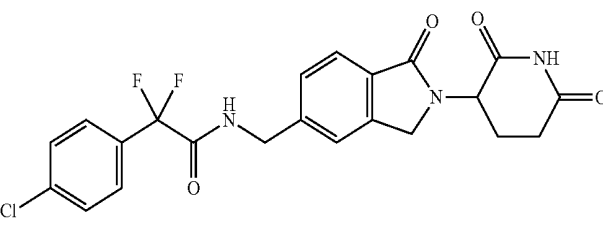


TABLE 1-continued

Summary of physical and chemical properties of 2-(4-Chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide	
Structure	
Molecular Weight	461.85
Log D	cLogP = 2.18 (Log D not measured due to solubility)
pKa	cpKa = 10.66 (Not measured due to low stability above pH 7)
Melting Point	234° C. (Form C)
Appearance	White powder
Solubility	Practically insoluble in water (≤ 1 μ g/ml across pH range of 1-8)
Solid State	DS is physically stable under all storage conditions.
Stability	
Solution	DS is not stable in solution at pH of 5.0 or above. Hydrolysis is the major degradation pathway.
Stability	
Hygroscopicity	Not hygroscopic
Pharmaceutical Form	Crystalline; Anhydrous; five polymorph forms (Form C being the most stable form)

Example 1

First Formulation Screen

Due to the poor water solubility of Compound 1, Form C, a cosolvent system was required to solubilize the drug compound in a solution prior to lyophilization. Several solubilizing agents and solvents that were considered in this example include hydroxypropyl-beta-cyclodextrin (HP β CD), Sulfobutylether- β -cyclodextrin sodium salt (SBE β CD; Captisol®), Tert-butyl alcohol (TBA), and dimethylacetamide (DMA). The solubilities of Compound 1, Form A in various cosolvent systems were determined and the results are shown in Table 2.

TABLE 2

Vehicle	Form C (mg/ml)	Form A (mg/ml)
5% HP- β -CD	NT	0.03
10% HP- β -CD	NT	0.06
20% HP- β -CD	NT	0.15
5% Captisol ®	NT	0.03
10% Captisol ®	NT	0.06
20% Captisol ®	0.10	0.13
30% Captisol ®	0.19	0.30
40% Captisol ®	NT	0.32
TBA	NT	0.06
DMA	<166, >125	NT
20:80 TBA/pH 4.5 buffer	NT	0.01
40:60 TBA/pH 4.5 buffer	NT	0.19
60:40 TBA/pH 4.5 buffer	0.29	0.39
70:30 TBA/pH 4.5 buffer	0.31	0.42
80:20 TBA/pH 4.5 buffer	0.33	0.47
90:10 TBA/pH 4.5 buffer	0.23	0.35
80% TBA/15% pH 4.5 buffer/5% DMA	0.47	NT
80% TBA/10% pH 4.5 buffer/10% DMA	0.58	NT
70% TBA/25% pH 4.5 buffer/5% DMA	0.47	NT
70% TBA/20% pH 4.5 buffer/10% DMA	0.66	NT

It was found that HP β CD and SBE β CD had comparable solubilizing effects on Form A at a concentration range of 5-20%. When the SBE β CD concentration increased from 30% to 40%, the enhancement in drug solubility was very

limited. It was also found that the drug solubility reached the highest when the TBA/water ratio was at 80:20. The solubility measurements of Form C in selected cosolvent systems were conducted and the results are also shown in Table 2.

In the first formulation screen, the focus was on various combinations of solvents and excipients that provided a media which allowed adequate drug solubility and stability throughout the process of lyophilization and storage of the final product. The 20 mM citrate buffer solution at pH 4.5 was used as the aqueous phase noting that the drug compound undergoes hydrolysis degradation in solutions at pH 5 or above. Given a target drug loading of 2 mg/vial and the maximum fill volume of 8 ml in a 20 cc vial container, the minimum feasible drug concentration in the bulk solution was 0.25 mg/ml. As shown in Table 2, The API has the highest solubility of 0.33 mg/ml in 80:20 TBA/pH4.5 buffer. However, the solubilities of many commonly used bulking agents such as mannitol, sucrose, and glycine are significantly limited in the 70% v/v or higher TBA solution. To balance the solubility of both API and the excipients in the bulk solution, a 60:40 TBA/pH4.5 citrate buffer solution was used in the first screen as the starting point.

In the first run of formulation screen, seven prototype formulations were prepared with different excipients: mannitol, sucrose, Plasdane C17, Captisol®, proline and glycine.

Table 3 shows the formulations compositions of the seven sublots in the first screen.

TABLE 3

Formulation No.	I	II	III	IV	V	VI	VII
API (mg/ml)	0.24	0.24	0.28	0.24	0.24	0.24	0.26
Mannitol (mg/ml)	21		25		21		
Plasdane C17 (mg/ml)		17					
Sucrose (mg/ml)				25			
Glycine (mg/ml)				17			19
PEG300 (mg/ml)					4		
Captisol ® (mg/ml)						17	
Proline (mg/ml)							7

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TABLE 3-continued

Formulation No.	I	II	III	IV	V	VI	VII
TBA (% v/v)	60	68.6	55.7	58.1	60	59.6	56.9
20 mM citric buffer (% v/v)	40	31.4	39.3		40		
DMA (% v/v)			4.9				1.6
Purified water (% v/v)				39.7		39.7	39
0.1N HCl (% v/v)				2.2		0.3	2.5
0.1N NaOH (% v/v)						0.4	

In Formulations I, II and V, the excipients were dissolved in 20 mM citric buffer solution (pH=4.7) first, then mixed with TBA. Subsequently API was dissolved in the TBA/buffer mixture. In Formulations IV and VI, the excipients were dissolved in purified water followed by a pH adjustment with HCl and the addition of TBA. Then the drug was directly dissolved in the TBA/water mixture. In Formulations III and VII, the API was dissolved in a small amount of DMA first, and then added to the TBA/buffer or TBA/water solution. It was observed that the solution became hazy after the addition of TBA in Formulations IV and VII. It was suspected that glycine in those formulations may have reached its solubility limit in the TBA/water solution.

The pH values of the bulk solution in each preparation step were measured and reported in Table 4.

TABLE 4

Sublot (Formulation Nos.)	I	II	III	IV	V	VI	VII
PH of excipients in Water or Buffer	4.8	4.8	4.7	6.2	4.8	5.0	6.2
pH of excipients post TBA addition	5.7	6.1	5.6	5.0	5.8	5.2	4.9
pH post API addition	5.8	6.1	5.9	5.0	5.8	5.2	5.0
Final pH (pre filtration)	5.8	6.1	5.9	5.0	5.8	5.2	5.0
Final pH (post filtration)	5.8	6.1	5.9	5.0	5.6	5.3	5.1
Post reconstitution	4.9	5.0	5.0	4.7	5.0	7.7	4.6

API addition and filtration had no impact on the pH of the solution. The addition of TBA to the solution caused a big increase in the pH reading, which may not reflect the true pH of the solution because the presence of the organic solvent often interferes with the measurement of the pH meter probes. The pH values of the solutions post reconstitution with purified water were all kept at 5.0 or less except for Formulation VI. A generic and conservative lyophilization cycle was applied to all the seven screened formulations and the process parameters of each freeze drying step were described in Table 5.

TABLE 5

Step	Shelf Temp. Setpoint (° C.)	Soak Time (hours)	Ramping Rate (° C./hour)	Pressure Setpoint
Product Loading/Freezing	5	2	30	Evac. To 12 psia to ensure chamber is airtight
Freezing	-50	3	30	60 microns
Primary Drying	-28	21	30	

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TABLE 5-continued

Step	Shelf Temp. Setpoint (° C.)	Soak Time (hours)	Ramping Rate (° C./hour)	Pressure Setpoint
Secondary Drying	25	6		
Stoppering	25			14.7 PSIA

All the seven formulations displayed acceptable cake appearances after lyophilization. The assay and purity of the lyophilized cakes were measured by HPLC and the moisture content of each formulation was measured by Karl Fisher. The results are shown in Table 6.

TABLE 6

Sublot (Formulation Nos.)	I	II	III	IV	V	VI	VII
Purity (% area)	99.3	71.7	99.3	99.2	99.4	99.2	84.6
Assay (% LC)	95.4	93.9	95.9	112.1	108.3	106.5	78.3
Moisture content (% w/w)	-0.09	0.30	0.04	1.27	0.03	0.16	0.21

Formulation VII was ruled out due to its low assay and purity, indicating that glycine and proline may not be adequate stabilizers in the lyophilization process. Formulation II showed low purity due to many interfering peaks of the polymeric excipient in the HPLC chromatograph. It remained to be investigated in the next run.

A few key observations concluded from the first screen are:

Adjusting pH with HCl and/or NaOH exhibited limited buffering capacity and introduced pH variation during the process. Using citrate buffer offered more consistent and robust pH control.

Dissolving the drug substance first to DMA and then adding the API/DMA premix to the respective TBA/buffer solution aided in initial dissolution of the drug substance, which allowed for higher drug concentration and lower TBA concentration in the final bulk solution.

Formulation VI, the formulation containing Captisol®, was able to be reconstituted by purified water or D5W alone at a concentration of 0.24-0.5 mg/ml. All the other formulations required some cosolvents such as ethanol or PEG300 for complete reconstitution.

Example 2

Second Formulation Screen

The preliminary results from the first screen confirmed the lyophilization feasibility of the drug compound. The second formulation screen was designed to evaluate the physical and chemical stability of multiple prototype formulations and to select the lead formulation candidates. The same generic lyophilization cycle as used in the first screen was adopted. 20 mM citrate buffer at pH 4.5 was used in all the formulations except for the one containing glycine (Formu-

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lation XIV). API was dissolved in DMA first at a concentration of 40 mg/ml. Then the API/DMA premix was added to the TBA/buffer solution containing the excipients. Dexolve and Kleptose® HPB are the two derivatives of cyclodextrins which have similar physical and chemical properties as Captisol®. They were included in Formulations VIII, IX and X as the alternatives of Captisol®. Mannitol, Plasdolone, sucrose and glycine exhibited acceptable formulation characteristics in the first screen and thus continued to be evaluated in the second screen. The excipient levels were adjusted empirically in order to obtain a clear and colorless bulk solution. Formulation XI, the formulation containing human serum albumin (HSA), was discarded during the preparation due to incomplete dissolution of the API. The formulation compositions of the seven sublots are shown in Table 7.

TABLE 7

Formulation No.	VIII	IX	X	XII	XIII	XIV	XV
API (mg/ml)	0.28	0.24	0.3	0.3	0.3	0.28	0.28
Mannitol (mg/ml)							12
Plasdolone C17 (mg/ml)				13.3			
Sucrose (mg/ml)					13.3	12	
Glycine (mg/ml)						6.1	
PEG300 (mg/ml)			6.6				
Dexolve (mg/ml)	24.5						
Kleptose® (mg/ml)		21.5	13.3				
TBA (% v/v)	50.4	56.6	46.3	46.3	46.3	50.4	50.4
20 mM citric buffer (% v/v)	49	42.9	53	53	53		49
DMA (% v/v)	0.7	0.6	0.7	0.7	0.7	0.7	0.7
Purified water (% v/v)						49*	

The fill volume of each vial was about 2.5-3 ml to deliver a drug loading of 0.75-0.77 mg/vial. The total solid content of the lyophilized cakes ranged from 40 mg to 75 mg per vial. As shown in Table 8, the pH values of the bulk solutions post reconstitution were all kept around 4.5, which confirmed the buffer capacity of the formulation.

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TABLE 8

Sublot (Formulation No.)	VIII	IX	X	XII	XIII	XIV	XV
pH of excipients in Water or Buffer plus TBA	4.6	4.7	4.7	4.8	4.8	4.6	4.7
pH post API and TBA addition	5.2	5.5	5.2	5.2	5.3	4.7	5.3
Final pH (post filtration)	5.1	5.6	5.4	5.4	5.4	4.9	5.3
pH Post reconstitution	4.5	4.6	4.5	4.5	4.5	4.4	4.5

The physical structures of the seven formulations after lyophilization were fully characterized and the results are shown in Table 9.

TABLE 9

	Formulation			
	VIII	IX	X	XII
Color	White, Uniform	White, Uniform	White, Uniform	White, Uniform
Structure	Dense	Dense	Porous	Powder
Fill Height	9 mm	8 mm	5 mm	5 mm
Cake Height	4 mm	6 mm	3 mm	n/a
Side	2 mm uniform	1 mm uniform	2 mm	n/a
Shrinkage				
Top Surface	Matte	Sheen	Matte/Sheen	n/a
Side Surface	Matte	Matte	Matte	n/a
Topography	Textured, concave	Textured, concave	Textured, concave	n/a
Upon Inversion	Cake remains intact and falls to top of vial.	Cake remains intact and adhered to bottom of vial.	Cake remains mostly intact with some chunks dislodged.	n/a
Upon Jarring	Cake fractures into pieces.	Cake falls to the top of vial and remains intact	Cake fractures into chunks.	n/a powder.
Residual Material	Minimal; bottom with striations	Minimal; bottom with striations	Minimal	Minimal

Formulations VIII, XIX and XV exhibited elegant cake appearances while Formulations X, XII, XIII and XIV did not retain a good cake structure, with collapsed or fractured chunks of powders in the vial.

All the lyophilized samples were put on stability at 25° C./60% RH and 40° C./75% RH condition. The assay and purity data of each formulation are shown in Table 10. The results indicated that all the formulations in the second screen remained chemically stable for at least 1 month at the long-term and the accelerated stability condition.

TABLE 10

Formulation	VIII	IX	X	XII	XIII	XIV	XV
Initial	Purity (% area)	97.8	98.5	99.5	98.7	98.2	98.5
	Assay (% LC)	93.5	92.1	90.7	92.0	95.2	96.1
40° C./75% RH	Purity (% area)	97.8	98.6	99.3	98.8	98.4	98.7
1 wk	Assay (% LC)	93.5	93.4	92.0	93.3	97.3	100.0
40° C./75% RH	Purity (% area)	97.9	98.5	99.3	98.8	98.2	98.7
							99.1

TABLE 10-continued

Formulation		VIII	IX	X	XII	XIII	XIV	XV
2 wk	Assay	96.1	96.1	93.3	96.0	93.3	93.5	102.6
	(% LC)							
40° C./75% RH	Purity	97.8	98.6	99.1	98.9	98.4	98.9	99.2
	(% area)							
4 wk	Assay	97.4	96.1	97.3	96.0	94.7	90.9	106.5
	(% LC)							
25° C./60% RH	Purity	97.9	98.5	99.3	98.8	98.2	98.6	99.1
	(% area)							
2 wk	Assay	96.1	96.1	93.3	96.0	90.7	97.4	102.6
	(% LC)							
25° C./60% RH	Purity	97.8	98.6	99.4	98.8	98.2	98.7	99.2
	(% area)							
4 wk	Assay	97.4	96.1	93.3	96.0	93.3	101.3	106.5
	(% LC)							

The physical stability of the seven formulations were characterized by XRPD. The results are illustrated in FIGS. 30A, 30B and 30C. For the initial samples, all the formulations exhibited amorphous forms except for Formulation XIV and XV. A further scan verified that Formulation XIV peaks corresponded to the β -form of glycine and Formulation XV peaks corresponded to the mixed α -form and δ -form of mannitol. After the stability samples were stored at 25° C./60% RH for 1 month, a few small peaks of sucrose showed up in the XRPD profile of Formulation XIV in addition to the glycine peaks, and the sucrose peaks also showed up in the XRPD patterns of the Formulation XIII sample. The similar changes in XRPD patterns were observed in the Formulations XIII and XIV 1-month stability samples at 40° C./75% RH to a greater extent. In the mean time, a couple of Formulations XIII and XIV samples after one month storage at 40° C./75% RH were found to exhibit slight color change from off-white to yellowish and the lyophilized powders became tacky.

The reconstitution study was executed on each formulation with four different diluents, namely purified water, D5W, 50% v/v ethanol solution, and 50% v/v PEG300 in D5W solution. The shaking time required for the complete dissolution and the physical appearance of the reconstituted solution were inspected. The results are shown in Table 11.

TABLE 11

Sublot	Purified Water (3 mL)	D5W (2 mL)	50:50 Ethanol/ water (4 mL)	50:50 PEG300/ D5W (2 mL)
Formulation VIII	20 s c/c; became hazy after 2 h	20 s c/c; became hazy after 2 h	30 s, c/c	30 s, c/c
Formulation IX	40 s c/c; became hazy after 2 h	40 s c/c; became hazy after 2 h	30 s, c/c	30 s, c/c
Formulation X	40 s c/c; became hazy after 2 h	40 s c/c; became hazy after 2 h	30 s, c/c	30 s, c/c
Formulation XII	>25 m Slightly cloudy	>25 m Slightly cloudy	30 s, c/c	30 s, c/c
Formulation XIII	>25 m Slightly cloudy	>25 m Slightly cloudy	30 s, c/c	30 s, c/c
Formulation XIV	>25 m Slightly cloudy	>25 m Slightly cloudy	30 s, c/c	30 s, c/c
Formulation XV	>25 m Slightly cloudy	>25 m Slightly cloudy	30 s, c/c	30 s, c/c

Formulation VIII, the dexolve-based formulation, was able to be reconstituted to a clean and colorless solution with 2-3 ml purified water or D5W alone within 20 seconds. Formulations IX and X, the Kleptose®-based formulations,

were able to be reconstituted with 2-3 ml purified water or D5W alone as well, but the complete reconstitution required 40-60 seconds. The reconstituted solutions of all the three formulations became hazy after 2 hours, implying that a larger volume of reconstitution diluent may be required to achieve longer in-use stability before the drug is precipitated out of the solution. The rest of the four formulations were not able to be reconstituted by the same volume of the purified water or D5W alone. When 50:50 ethanol/water solution or 50:50 PEG300/D5W solution was used as the reconstitution diluent, all the seven formulations were able to be reconstituted with 2 ml of the diluent within 30 seconds. As the solvent-free diluent is most preferable in terms of easiness of formulation preparation and excipient tolerability, the Dexolve or Kleptose® based formulations are advantageous over the other formulation candidates.

The moisture content of a lyophilized sample could have great impact on its physical and chemical stability. The water content of each lyophilized sample was measured by Karl Fisher. As shown in Table 12, the water contents of all the formulations were less than 0.5% except for Formulation XIV which had a water content of 1.25%.

TABLE 12

Formulation Nos.	KF Residual Water (% w/w)	TGA Weight Loss (% w/w)	First (Lowest) thermal event (peak ° C.)
Formulation VIII	0.50	3.07 (loss 1) 4.21 (loss 2)	120.8
		7.28 (Total)	
Formulation IX	0.04	11.4	93.7
Formulation X	-0.09	2.79	86.5
Formulation XII	0.08	6.04	80.8
Formulation XIII	-0.17	2.98	n/d
Formulation XIV	1.25	6.74	47.3
Formulation XV	0.14	3.07 (loss 1) 2.02 (loss 2)	(46.8 exo) 179.1
		5.09 (Total)	

The total weight loss of each lyophilized sample upon heating from room temperature up to 200° C. was obtained from the TGA measurement. Given the low water content of each sample as indicated in the Karl Fisher measurement, the majority of the weight loss was attributed to the residual solvent held in the lyophilized cake. It showed in Table 12 that the weight loss across all the formulations ranged from 2.8% to 11.4%, implying that most of the lyophilized samples carried relatively high residual solvents. Residual solvent level of the final drug products may cause serious toxicity concerns and therefore need to be tightly controlled according to the ICH guideline Q3C. A GC method was developed upon this point for the quantification of the residual solvent level of the lyophilized formulations for the further development work. The DSC measurement was also conducted on each sample to characterize the thermal response of the lyophilized material. The lowest peak temperature of the first endothermic event identified from the DSC profile reflects the glass transition temperature of the amorphous material. Formulations VIII, IX and XV showed relatively higher glass transition temperatures than the other formulations. In correspondence, these three formulations also exhibited better cake appearance and integrity than the others. Formulations XIII and XIV had the lowest glass

transition temperatures among the seven screened formulations, which partially explained their weak physical stability observed at the accelerated stability condition.

Example 3

Third Formulation Screen

As the cake integrities of several formulations in the second screen were not as good as expected, the bulking agent level in the formulations was increased to help stabilize the cake structure during the lyophilization cycle. In order for the bulking agents to achieve a concentration of 50 mg/ml, it was found that the TBA concentration in the bulk solution should be kept at 55% v/v or less. The new lot of API material was dissolved in DMA at a concentration of 60 mg/ml and then added to 50% TBA in citrate buffer solution. The drug concentration in the final bulk solution may increase from previous 0.3 mg/ml up to 1 mg/ml with the increased ratio of API/DMA concentrate. In the third screen, in order to achieve a target drug loading of 2 mg/vial, the drug concentration in the final bulk solution was set at 0.5 mg/ml, corresponding to 4 ml of the fill volume in the vial. Formulations XVI-XXII carried on the same bulking agents as used in the previous screen but at a higher bulking agent level of 50 mg/ml. In Formulation XXIII, a combination of Captisol® and Plasdane C17 was used as bulking agents to test if the addition of the polymer would enhance the solubility of the drug compound so that the same drug concentration can be achieved at a lower TBA level of 30% v/v instead of 50% v/v. Table 13 shows the formulation compositions of the bulk solutions in the third screen.

TABLE 13

Formulation No.	XVI	XVII	XVIII	XIX	XX	XXI	XXII*	XXIII
API (mg/ml)					0.5			
Mannitol (mg/ml)					50			
Plasdane C17 (mg/ml)			50					5
Sucrose (mg/ml)						50	35	

TABLE 13-continued

Formulation No.	XVI	XVII	XVIII	XIX	XX	XXI	XXII*	XXIII
Glycine (mg/ml)							15	
Captisol® (mg/ml)		50						45
Dexolve (mg/ml)	50							
Kleptose® (mg/ml)			50					
TBA (% v/v)					49.58			29.75
Citric buffer (% v/v)					49.58			69.42
DMA (% v/v)					0.83			

*pH adjusted by HCl instead of citric buffer

The pH values of the final bulk solutions and the solution post reconstitution of all the screened formulations were kept well below 5.0, as shown in Table 14.

TABLE 14

Sublot	Formulation XVI	Formulation XVII	Formulation XVIII	Formulation XIX	Formulation XX	Formulation XXI	Formulation XXII	Formulation XXIII
pH of excipients in 50% v/v TBA/water	4.6	4.7	5.0	5.0	5.0	5.0	4.3	4.5
Final pH including API (post filtration)	4.9	4.9	5.2	5.2	5.1	5.1	4.4	4.7
Post reconstitution	4.3	4.3	4.2	4.3	4.1	4.3	3.9	4.3

The same generic lyophilization cycle as used in the first screen was adopted in this study. The physical structures of the eight lyophilized formulations were fully characterized and the results are shown in Table 15.

TABLE 15

Characteristic	Formulation XVI	Formulation XVII	Formulation XVIII	Formulation XIX
Color	White, Uniform	White, Uniform	White, Uniform	White, Uniform
Structure	Dense	Dense	Dense	Dense
Fill Height	8 mm	8 mm	8 mm	8 mm
Cake Height	3-5 mm	4-5 mm	6-8 mm	3-6 mm
Side Shrinkage	3 mm uniform	2 mm uniform	1 mm uniform	2 mm uniform
Top Surface	Matte	Matte	Matte w/ a sheen skin	Matte and Sheen
Side Surface	Matte	Matte	Matte, with slight creep up the sides	Matte, with slight creep up the sides
Topography	Textured, concave at edges, multiple peaks	Textured, concave at edges, multiple peaks	Textured, concave at edges, $\frac{2}{3}$ of surface has a sheen skin	Textured, concave at edges, surface is slightly porous
Upon Inversion	Cake remains intact and falls to top of vial.	Cake remains intact and falls to top of vial.	Cake remains intact and falls to top of vial,	Cake remains intact and falls to top of vial.

TABLE 15-continued

Upon Jarring	Cake falls to top of vial Small pieces fall off.	Cake falls to top of vial and breaks into pieces.	Cake falls to top of vial and breaks into pieces.	Cake falls to top of vial Small pieces fall off.
Residual Material	Minimal	Minimal	Minimal	Minimal
Characteristic	Formulation XX	Formulation XXI	Formulation XXII	Formulation XXIII
Color	White, Uniform	White, Uniform	White, Uniform	White, Uniform
Structure	Dense	Dense	Porous	Dense
Fill Height	8 mm	8 mm	8 mm	8 mm
Cake Height	7-8 mm	4-5 mm	3-4 mm	3-5 mm
Side Shrinkage	2 mm uniform	2 mm uniform	N/A	2 mm uniform
Top Surface	Matte and Sheen	Matte and Sheen	Matte	Matte and Sheen
Side Surface	Matte, with small creep up the sides	Matte, with slight creep up the sides	Matte	Matte
Topography	Textured, concave at edges, multiple peaks	Textured, concave at edges, multiple peaks	Textured	Smooth concave along the edges, 1/2 of surface has a skin.
Upon Inversion	Cake remains intact and falls to top of vial.	Cake remains intact and falls to top of vial.	Cake remains intact and falls to top of vial.	Cake remains intact and falls to top of vial.
Upon Jarring	Cake falls to top of vial and powderizes	Cake falls to top of vial and breaks into pieces.	Cake falls to top of vial and powderizes	Cake falls to top of vial Small amount falls off.
Residual Material	Significant	Minimal	Minimal	Minimal

With the increased level of the bulking agents, all the formulations obtained acceptable cake appearance except for Formulation XXII, the one containing sucrose and glycine. The observation was consistent with what had been seen in Formulation XIV which contained lower levels of sucrose and glycine. As a result of the poor cake integrity and the deteriorated physical stability observed in the second screen, the formulations containing sucrose and/or glycine were ruled out.

The reconstitution performance of the eight formulations in the third screen was consistent with that observed in the second screen. Formulations XVI, XVII, XVIII, the cyclodextrin-based formulations, are the only three formulations that can be reconstituted by purified water or D5W alone. All the rest formulations required cosolvent diluent for complete dissolution including Formulation XXIII. Surprisingly, although it contained Captisol®, the drug solubility of Formulation XXIII was limited rather than enhanced by the presence of Plasdone. Therefore Formulation XXIII was abandoned from the screen.

The Karl Fisher, DSC, and TGA results were summarized in Table 16.

TABLE 16

Sublot	KF Residual Water (% w/w), 2 vials	TGA Weight Loss (% w/w)	First (Lowest) DSC Thermal Event (peak ° C.)
Formulation XVI	0.11, 0.03	2.42 (loss 1) 3.68 (loss 2)	112.7
Formulation	0.18, 0.06	6.10 (Total) 2.96 (loss 1)	126.5

TABLE 16-continued

Sublot	KF Residual Water (% w/w), 2 vials	TGA Weight Loss (% w/w)	First (Lowest) DSC Thermal Event (peak ° C.)
XVII		5.05 (loss 2)	
40 Formulation XVIII	0.08, 0.00	8.01 (Total) 1.61 (loss 1) 9.29 (loss 2)	89.6
45 Formulation XIX	0.11, 0.02	10.90 (Total) 1.81 (loss 1) 6.60 (loss 2) 3.55 (loss 3)	95.0
Formulation XX	0.15, 0.30	11.96 (Total) 1.41 (loss 1) 0.21 (loss 2)	98.5
50 Formulation XXI	0.03, 0.05	1.62 (Total) 1.82 (loss 1) 0.78 (loss 2) 2.75 (loss 3) 2.46 (loss 4)	64.6
55 Formulation XXII	0.23, 0.33	7.81 (Total) n/d	58.7
Formulation XXIII	0.41, 0.28	2.09 (loss 1) 5.37 (loss 2)	105
60		7.46 (Total)	

The water contents detected by the Karl Fisher measurements showed that all the formulations contained less than 0.5% water. However, the TGA results indicated that the weight loss of each formulation upon heating varied in a wide range, which predominantly resulted from a high level of residual solvent in the lyophilized cakes. Formulations

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XVIII and XIX contained relatively higher residual solvent levels than the other formulations, plausibly due to the tendency of solvent molecules bound with the sugar ring of the cyclodextrin and polymeric chain of the povidone. Formulation XX, the mannitol-based formulation, contained the lowest residual solvent of 1.6%. Table 17 provides residual solvents of the selected formulations from the third screen.

TABLE 17

Formulation	TBA (mg/vial)	DMA (mg/vial)
Formulation XVI (Dexolve)	1.4	11.0
Formulation XVII (Captisol®)	9.0	19.1
Formulation XVIII (Kleptose®)	11.7	11.0
Formulation XX (Mannitol)	0.12	3.18

With the completion of the third formulation screen, the Captisol® or Dexolve-based formulation stood out as the lead candidate due to its good physical and chemical stability as well as its fast and simple reconstitution. The Kleptose®-based formulation was considered as the alternative as it displayed similar characteristics as the Captisol®-based formulation. The mannitol-based formulation was also considered as the backup due to its superior cake structure and the lowest residual solvent level among all the screened formulations.

The GC tests were conducted on the aforementioned four lead formulations to acquire a more definite amount of the residual solvents in each individual vial. Therefore, the next run of formulation screen was focused on reducing the solvent level used in the initial bulk solution. Dexolve was used as the sole bulking agent in the screen provided the drug has comparable solubility in Captisol®, Dexolve, or Kleptose® solutions.

Example 4

Fourth Formulation Screen

All the previous formulation development work was targeted at a drug loading of 2 mg/vial. A drug concentration as high as 0.5 mg/ml was achieved by dissolving the API first in DMA at the concentration of 60 mg/ml and then adding the DMA concentration in 50:50 TBA/citrate buffer solution. In order to minimize the residual solvent level in the finished lyophilized drug product, a few approaches were considered:

1. Reducing the initial TBA amount may lead to less residual TBA.
2. Reducing the initial DMA amount may lead to less residual DMA.
3. Reducing the initial cyclodextrin amount may diminish the solvent entrapment in this excipient.
4. Optimizing the freeze drying parameters may facilitate removal of solvents in both sublimation and desorption processes.

To reduce the initial TBA amount in the formulation, a small study was conducted to evaluate the API solubility in varying levels of TBA in the Dexolve-based lead formulations. API was dissolved in DMA at 50 mg/ml and then added to the solution containing Dexolve, citrate buffer and TBA. Table 18 shows the formulation compositions in the solubility study.

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TABLE 18

	Formulation		
	XIV	XV	XVI
API (mg/ml)		0.5 (added as a 50 mg/ml solution in DMA)	
Dexolve-7 (mg/ml)		50	
20 mM Citrate Buffer (% v/v)	80	70	60
TBA (% v/v)	20	30	40

It was observed that no clear solution was obtained when TBA level was 30% v/v or less. This suggested that a minimum 35-40% v/v TBA is required to maintain a drug concentration at 0.5 mg/ml in the bulk solution. If DMA and/or Dexolve level is also reduced, an even higher level of TBA would be needed. There is little room to move the TBA level down from 50% v/v level used in the third screen. Therefore, it was decided to reduce the target drug concentration in the fourth screen in order to achieve lower solvent content. Given a maximum fill volume of 8 ml in a 20 cc vial and a drug loading of 1 mg/vial instead of 2 mg/vial, the lowest drug concentration to be formulated is 0.125 mg/ml.

The bulk solution compositions of the five formulations in the fourth screen were described in Table 19.

TABLE 19

	Formulation				
	XXVII	XXVIII	XXIX	XXX	XXXI
API (mg/ml)	0.125	0.125	0.125	0.25	0.40
Dexolve-7 (mg/ml)			20		
20 mM Citrate Buffer (% v/v)	100	75	75	70	65
TBA (% v/v)	n/a	25	25	30	35
DMA (% v/v)	0.25	0.25	n/a	0.50	0.79
Fill volume (ml/vial)	8.24	8.24	8.24	4.12	2.5
Total solid content (mg/vial)	203	194	194	74	68

Formulations XXVII, XXVIII and XXIX were all prepared at a drug concentration of 0.125 mg/ml. Formulation XXVII contained no TBA while Formulation XXVIII and XXIX contained 25% v/v TBA. Formulation XXIX contained no DMA while Formulation XXVII and XXVIII both had the drug added as a 50 mg/ml solution in DMA. Formulations XXX and XXXI had relatively higher levels of TBA at 30% v/v and 35% v/v, respectively. As a result, they were able to achieve a higher drug concentration at 0.25 mg/ml and 0.40 mg/ml, respectively. Based on the result from the first screen, the formulation containing Captisol® at 17 mg/ml obtained an acceptable cake structure. Therefore, Dexolve at a concentration of 20 mg/ml instead of 50 mg/ml was used in the new screen to mitigate the solvent entrapment tendency. In the lyophilization cycle of the fourth screen, all the cycle parameters were kept the same as in the previous studies except for the secondary drying. The shelf temperature in the secondary drying step was increased from 25° C. to 40° C. and the drying time was prolonged from 6 hours to 12 hours.

All the five formulations obtained good freeze-dried cake materials, with Formulation XXVII providing the most elegant cake appearance. After being reconstituted with 4 ml D5W, drug precipitation was observed in Rx30 vial within 60 minutes. The other formulations post reconstitution stayed in clear solution for at least 3 hours based on visual observation.

The weight loss of the lyophilized samples measured by TGA was reduced to a great extent as compared with previous lots. In correspondence, the residual solvent level of each formulation detected by the GC method was also reduced, as shown in Table 20.

TABLE 20

Formulation	TBA (mg/vial)	DMA (mg/vial)	Weight loss from TGA (% w/w)
XXVII	0.05	11.34	1.55
XXVIII	8.81	8.18	
XXIX	4.67	n/a	3.99
XXX	3.01	4.69	
XXXI	2.25	2.86	2.17

Both the TBA level and the DMA level decreased with the decrease of the total solid content of the lyophilized cake. It was speculated that the less solid content led to the smaller cake thickness, which resulted in higher heat transfer efficiency for the solvent to be removed from the cake. The tiny amount of TBA found in Formulation XXVII was suspected to come from cross contamination. As the TBA-free formulation is the most preferable from the toxicology and regulatory perspective, Formulation XXVII was considered as the primary formulation to move forward in the next stage of formulation development. Formulation XXXI was considered as the backup along with Formulation XX, the mannitol-based formulation. During the formulation preparation, Dexolve revealed some quality issues such as the presence of unknown fibers and large colored particles. Besides, despite its comparable physical and chemical properties with Captisol®, it has not been used in any FDA approved IV drug products, which is a potential regulatory

mg/ml to 30 mg/ml to provide some solubility margin as the DMA cosolvent level in the bulk solution was to be further reduced in the process development. The other two formulations, II and III, contained 40-50% TBA to accommodate a higher drug loading than the TBA-free formulations.

Example 5

Thermal Analysis of Lyophilization Formulations

Prior to the process development work, a series of low temperature thermal analysis work were conducted on each of the four lead formulations listed in Table 21 to characterize the physical and chemical behaviors of the formulations in a freeze drying process. In the electrical resistance (ER) measurement, the material was cooled and warmed at an average controlled rate and the deviation in resistance was used to determine an onset temperature of the phase transition upon warming. In the freeze-drying microscope (FDM) measurement, the material was cooled and warmed in a sample cell under the temperature controlled freeze drying stage. Changes in the frozen and dried portions of the sample during the phase transition were visually observed under the microscope and the onset temperature was recorded. In the low temperature differential scanning calorimetry (LT-DSC) method, the sample was cooled to a complete freezing first, and then was warmed at a modulated heating rate. The glass transition event was detected in a resultant reversing heat flow. The minimum freezing temperature required for complete solidification during freezing, the phase transition temperature upon warming, and the temperature at which the first void in the frozen material was observed under FDM upon warming were identified and summarized in Table 22.

TABLE 22

	Freezing Temp. (FDM)	Freezing Temp. (ER)	Phase Transition Temp. (ER)	Glass Transition Temp. (LT-DSC)	Initial Void Temp. upon warming (FDM)	Product Temp. Range
Formulation IA	-21.2° C.	-26° C.	-27° C.	-36.6° C.	-30° C.	-32 to -34° C.
Formulation IC	-22.9° C.	-12° C.	-12° C.	-20.4° C.	-13.6° C.	-16 to -18° C.
Formulation III	-22.1° C.	-20° C.	-20° C.	-34.9° C. (Exotherm)	-41.2° C.	-44 to -46° C.
Formulation III	-21.2° C.	-20° C.	-17° C.	-33.5° C. (Endotherm)	-32° C.	-36 to -38° C.

barrier for its use in the clinical study. Hence Captisol® and Kleptose® were used instead in the further development work.

Four formulations were selected out of the formulation screen as the lead candidates for the further process development. The four formulations are shown in Table 21.

TABLE 21

	Formulation IA	Formulation IC	Formulation II	Formulation III
API (mg/mL)*	0.125	0.125	0.40	0.50
Excipients	Captisol® (30 mg/mL)	Kleptose® (30 mg/mL)	Captisol® (20 mg/mL)	Mannitol (50 mg/mL)
Citrate buffer (% v/v)	100	100	60	50
TBA (% v/v)	0	0	40	50

The cyclodextrin levels of the two TBA-free formulations, Formulations IA and IC, were increased from 20

In general, the ER results are for reference only and not so specific as FDM or LT-DSC results. The visual results obtained from FDM are considered to be most representative to what occurs in the vial. A recommended product temperature range during primary drying was determined thereafter for complete sublimation with the retention of the cake structure and the absence of collapse. In some cases, the product may still remain stable when the product temperature is slightly higher than the glass transition temperature. Typically the product is kept 2-3° C. below the initial void temperature, which is considered to be representative of the collapse temperature of the lyophilized cake, to provide some safety margins. For the mannitol-based formulation III, LT-DSC results indicated an exothermic event in the 2° C./min scan which was not seen in the 10° C./min scan. This suggested that the event is warming rate dependent. The formulation may benefit from an annealing step prior to primary drying to allow efficient crystallization of the crystalline bulking agent mannitol. The thermal analysis results,

especially the recommended product temperature range for primary drying, were used as references in the subsequent process development work.

Example 6

Development of Lyophilization Process

A lyophilization process may consist of three stages: freezing, primary drying, and secondary drying. A liquid formulation is transformed to a lyophilized powder form by going through complete solidification through freezing stage, sublimation of ice and solvents through primary drying, and desorption of residual moisture and solvents through secondary drying. The shelf temperature and chamber pressure in the primary drying and secondary drying are the key process parameters which have great impact on the quality of the finished drug product. Five process development studies were executed to investigate the effect of each key process parameter on the quality of the final lyophilized product. A series of tests were conducted on the finished drug product. The cake appearance and structure was characterized by visual inspection. The reconstituted solution was characterized by visual inspection and the pH measurement. The moisture content of the lyophilized cake was measured by Karl Fisher method. The physico-chemical behaviors of the dried cake at elevated temperatures were characterized by differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA). The residual solvent level was quantified by gas chromatography (GC) method. The assay and purity was measured by HPLC.

Example 7

Influence of Shelf Temperature in Primary Drying on Finished Products

The objective of this study was to evaluate the influence of the shelf temperature on the product temperature during primary drying. The shelf temperature was elevated from -34°C . to -16°C . stepwise with the constant chamber pressure of 60 mTorr throughout primary drying. The four lead formulations described in Table 21 were compounded, filled into 20 ml glass vials, and lyophilized with a target drug loading of 1 mg/vial. The cycle parameters were displayed in Table 23.

TABLE 23

Step	Shelf Temp. Setpoint ($^{\circ}\text{C}$.)	Soak Time (hours)	Ramping Rate ($^{\circ}\text{C}$./hour)	Pressure Setpoint
Product Loading/ Freezing	5	2	30	Evac. To 12 psia to ensure chamber is airtight
Freezing	-50	3	30	60 microns
Annealing	-18	3	30	
Freezing	-50	3	30	
Primary Drying	-34	1.5	30	
	-31	1.2		
	-28	1.0		
	-25	1.0		
	-22	0.8		
	-19	1.3		
	-16	77.6		
Secondary Drying	40	12.1		
Stoppering	40			14.7 PSIA

During the primary drying, it was observed that the product temperature of each formulation increased on average 0.8 - 1.4°C . per 3° increase in shelf temperature. The product temperature change was more prominent in Formulations II and III than in Formulations IA and IC. The product break temperatures, denoted as the product temperature at which the ice sublimation was completed, were -35.9°C ., -34.8°C ., -40.7°C ., and -40.1°C . for Formulations IA, IC, II and III, respectively. The break temperatures of all the formulations except for Formulation II were below the recommended product temperature ranges obtained from the low temperature thermal analysis. This suggested that collapse could have occurred in Formulation II while the other three formulations attained good retention of the cake structure.

The finished products of the four sublots showed acceptable cake appearance with varying degrees of shrinkage. The assay of each subplot was in an acceptable range of 95-105%. The residual moistures of the four sublots were all less than 0.2%. The lyophilized material was reconstituted with purified water at a volume of 2, 4, and 8 ml. Formulations IA, IC and II rendered a clear and colorless solution which stayed physically stable for 4 hours by visual inspection. Formulation III was cloudy and would require alternative diluent containing organic solvent. The pH of each reconstituted solution was in the range of 4.5-4.9. The residual solvent level of each subplot was quantified by GC and listed in Table 24.

TABLE 24

	Formulation IA	Formulation IC	Formulation II	Formulation III
Residual DMA (mg/vial)	7.64	6.37	4.74	0.58
Residual TBA (mg/vial)	0.04	0.05	2.11	0.07

According to the ICH guidance, DMA was considered as Class 2 solvent and the maximum daily uptake was set as 10.9 mg/day. This guidance does not apply to potential new drug products used during the clinical research stages of development. Hence the stated DMA limit is only used as a benchmark. TBA is not listed in the ICH guidance. The maximum daily uptake of residual TBA was set as 0.15 mg/day. Given a top dose of 2 mg/day, the residual DMA and TBA in finished products are expected to be below 5.45 mg/vial and 0.075 mg/vial respectively. All the formulations except for Formulation III exceeded the residual solvent limit. Therefore, process optimization was conducted to further reduce the residual solvent.

Example 8

Influence of Chamber Pressure in Primary Drying on Finished Products

This study was designed to evaluate the influence of the chamber pressure on the product temperature during primary drying. The chamber pressure was elevated from 40 mTorr to 200 mTorr stepwise with the constant shelf temperature at -34°C . throughout primary drying. The cycle parameters were described in table 25.

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TABLE 25

Step	Shelf Temp. Setpoint (° C.)	Soak Time (hours)	Ramping Rate (° C./hour)	Pressure Setpoint
Product Loading/ Freezing	5	2		Evac. To 12 psia to ensure chamber is airtight
Freezing	-50	3	30	
Annealing	-18	3	30	
Freezing	-50	3	30	
Primary Drying	-34	5.0	40 microns	
		0.8	50 microns	
		1.0	60 microns	
		1.2	70 microns	
		0.3	80 microns	
		21.5	90 microns	
		25.4	100 microns	
		16.8	120 microns	
		5.6	140 microns	
		27.5	160 microns	
			200 microns	
Secondary Drying	40	12.0	30	200 microns
Stoppering	40			14.7 PSIA

Four sublots were formulated in this study. Formulations IA, III and III were the same as illustrated in Table 21. The only difference from the process study Run #1 was that, the starting concentration of API in DMA was increased from 75 mg/ml to 120 mg/ml to lower the initial amount of DMA in the bulk solution. Formulation IC was not evaluated in this study as it was theorized that Formulation IA containing Captisol® may demonstrate comparable physical and chemical behaviors as Formulation IC, the Kleptose®-based formulation. Instead, Rx4, a Captisol® based, solvent-free formulation was added to the study plan to assess the feasibility of compounding the bulk solution with no aid of TBA or DMA. The formulation dissolves 0.125 mg/ml Form C directly in the same 20 mM citrate buffer solution with 300 mg/ml Captisol®. Drug precipitation was observed in Rx4 during the compounding process and the precipitated drug particles were filtered out prior to the lyophilization. Later a low assay value of 28.8% in the lyophilized sample of Rx4 subplot confirmed that the solvent-free formulation is not a viable option even with ten folds higher cyclodextrin to facilitate solubilization of the drug. Therefore Rx4 was not considered in the further studies.

During the primary drying, it was observed that the product temperature of the subplot Formulation IA, 2, and 3 increased on average 1.1° C. per 10 micron increase in the chamber pressure from 50 to 70 microns. From 80 to 140 microns, product temperature increased approximately 0.5° C. for each 10 micron increment. The product break temperatures were -36.7° C. and -37.7° C. for Rx2 and 3 respectively. The break temperature of Rx3 was within the recommended product temperature range, suggesting that Rx3 subplot was freeze dried with retention and absence of collapse. In contrast, the product break temperature of Rx2 was higher than the recommended product temperature range. Obvious collapse was observed in a few Rx2 sample vials. Formulation IA did not undergo a break temperature implying incomplete sublimation in these subplot vials.

The finished products of the four sublots showed acceptable cake appearance with varying degrees of shrinkage. The assay of the three subplot Formulation IA, II, and III were all in an acceptable range of 95-100%. The moisture content and the reconstitution results of the sublots Formulation IA,

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II and III in the process Run #2 were similar to those obtained in the process Run #1. The residual solvent level of each subplot was quantified by GC and listed in Table 26.

TABLE 26

	Formulation IA	Formulation IC	Formulation II	Formulation III
Residual DMA (mg/vial)	3.71	NA	2.21	0.4
Residual TBA (mg/vial)	0.04	NA	1.63	0.03

The reduced residual solvent levels of all the sublots in this study indicated that decreasing the initial amount of DMA charge in the bulk solution is an effective approach to minimize the residual DMA level in the finished drug product.

Example 9

Influence of Chamber Pressure in Secondary
Drying on Finished Products

This study was designed to evaluate the influence of a higher chamber pressure in the secondary drying on the residual solvent level of the finished drug products. Three formulation sublots, Formulation IC, II, and III were evaluated in this study. The compositions of each formulation were the same as listed in Table 21. The API was dissolved in DMA at a concentration of 120 mg/ml in all the three formulations in this study. Formulation IA was abandoned in this study as Kleptose® was considered advantageous over Captisol® due to similar chemical properties and lower material cost at this point. Based on the product temperature profiles derived from the previous two process studies, the shelf temperature and the chamber pressure of the primary drying in this study were set at -22° C. and 40 microns respectively in order to yield a product temperature range of -40° C. to -42° C. This conservative setting was to ensure all the three formulations retain the structure with absence of collapse during the primary drying. The chamber pressure of the secondary drying was increased from 40 microns to 600 microns in this study. It was expected that a higher chamber pressure would create a more nitrogen rich environment and more efficient heat transfer which may aid in desorption of residual solvents. The cycle parameters were described in Table 27.

TABLE 27

Step	Shelf Temp. Setpoint (° C.)	Soak Time (hours)	Ramping Rate (° C./hour)	Pressure Setpoint
Product Loading/ Freezing	5	2		Evac. To 12 psia to ensure chamber is airtight
Freezing	-50	3	30	
Annealing	-18	3	30	
Freezing	-50	3	30	
Primary Drying	-22	111	40 microns	
		4	40 microns	
			600 microns	
			600 microns	
Secondary Drying	40	12	600 microns	
Stoppering	40			14.7 PSIA

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In this study, the product break temperatures of Formulation IC ranged between -35.2°C . and -38.2°C ., much lower than the recommended product temperature range of -16°C . to -18°C . This implied that there is still a lot of room in the further lyophilization cycle optimization. The product break temperatures of Formulations II and III were -38°C . and -39°C . respectively. The break temperatures of Formulation II exceeded the recommended product temperature range, suggesting that a more conservative cycle would be needed for this formulation to avoid the collapse.

The finished products of the three sublots showed acceptable cake appearance with varying degrees of shrinkage. The moisture content and the reconstitution results of the sublots IC, II and III in the process Run #3 were similar to the results in the previous studies. The residual solvent level of each subplot was quantified by GC and listed in Table 28.

TABLE 28

	Formulation IA	Formulation IC	Formulation II	Formulation III
Residual DMA (mg/vial)	NA	6.22	2.7	0.62
Residual TBA (mg/vial)	NA	0.11	3.3	0.05

It showed that the residual DMA level in Formulation IC was still higher than the desired upper limit. Increase in the chamber pressure of the secondary drying had minimal effect on the solvent desorption.

Example 10

Influence of Shelf Temperature and Drying Time in
Secondary Drying on Finished Products

This study was designed to evaluate the influences of the shelf temperature and the drying time in the secondary drying on the residual solvent level of the finished drug product. Formulation IC was selected as the lead formulation to proceed due to its superior reconstitution performance. Two other variations, Formulations IC, XXXIII and XXXV, were added in this study to evaluate the influences of the excipients on the residual solvent. Formulation XXXIII differed from IC with a lower Kleptose® level of 20 mg/ml. The intent was to evaluate whether reducing Kleptose® concentration would help reduce the residual solvent. A previous solubility study showed that for Formulation IC, the minimum Kleptose® concentration was 25 mg/ml to assure complete drug dissolution in the bulk solution. Therefore when the Kleptose® concentration was reduced to 20 mg/ml in Formulation XXXIII subplot, the API was dissolved in DMA at 60 mg/ml instead of 120 mg/ml to ensure complete drug dissolution in the bulk solution. Formulation XXXV differed from IC with the addition of 40 mg/ml mannitol. The intent was to evaluate whether presence of mannitol providing a more crystalline structure in the lyophilized cake would promote the removal of the residual solvent. The compositions of the three formulations are listed in Table 29.

TABLE 29

	Formulation IC	Formulation XXXIII	Formulation XXXV
API (mg/mL)	0.125 (added as 120 mg/ml in DMA)	0.125 (added as 60 mg/ml in DMA)	0.125 (added as 120 mg/ml in DMA)

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TABLE 29-continued

	Formulation IC	Formulation XXXIII	Formulation XXXV
Excipients	Kleptose® (30 mg/mL)	Kleptose® (20 mg/mL)	Kleptose® (30 mg/mL) Mannitol (50 mg/mL)
Solvents		pH 4.5 citric Buffer (100% v/v)	

The shelf temperature and the chamber pressure of the primary drying in this study were set at -28°C . and 60 microns respectively to provide a conservative lyophilization cycle for all the formulations. An annealing step was added during the freezing stage to facilitate the crystallization of mannitol in Formulation XXXV. Secondary drying was conducted at an increased shelf temperature of 50°C . for 12, 18, and 24 hours. Sample vials were pulled out of the lyophilizer at each time point to check the residual solvent level change over time. The cycle parameters were described in Table 30.

TABLE 30

Step	Shelf Temp. Setpoint ($^{\circ}\text{C}$.)	Soak Time (hours)	Ramping Rate ($^{\circ}\text{C}$ /hour)	Pressure Setpoint
Product Loading/ Freezing	5	2	30	Evac. To 12 psia to ensure chamber is airtight
Freezing	-50	3	30	
Annealing	-18	3	30	
Freezing	-50	3	30	60 microns
Primary Drying	-28	104	30	60 microns
Secondary Drying	50	12, 18, 24		60 microns
Stoppering	50			14.7 PSIA

The product break temperature ranged from -33°C . to -36°C . in primary drying, which was way below the recommended product temperature of Formulation IC from LI-TA. This suggested that the current lyophilization cycle was too conservative and there was still room to increase the shelf temperature and/or the chamber pressure in primary drying to shorten the drying time in further development. The finished products of the three sublots showed acceptable cake appearance with varying degrees of shrinkage. The residual solvent level of each subplot was quantified by GC and listed in Table 31.

TABLE 31

Drying time	Formulation IC (mg/vial)	Formulation XXXIII (mg/vial)	Formulation XXXV (mg/vial)
12 hr	5.8	11.2	5.6
18 hr	5.7	11.2	5.8
24 hr	5.7	11.2	5.5

It showed that the residual DMA level in Formulation IC was reduced slightly from 6.2 mg/vial in Run #3 to 5.8 mg/vial. Prolonged drying time beyond 12 hour has no impact on the removal of the residual solvent. Formulation XXXIII showed the highest residual DMA level among the three sublots mainly because its initial DMA charge was

doubled the amount in the other two formulations. Formulation XXXV had similar residual DMA level as Formulation IC, indicating that addition of mannitol had little impact on the removal of the residual DMA. As the result showed a strong correlation between the initial DMA charge to the bulk solution and the residual DMA in the lyophilized cake, it was decided to further reduce the initial DMA charge in the formulation in the next study in order to bring down the residual solvent level.

Example 11

Refinement of the Formulation and Lyophilization Process Parameters

This study was designed to refine the formulation and process parameters of the lead formulation IC based on the previous process study results. First of all, a quick solubility study was conducted to evaluate the maximum feasible concentration of API in DMA. When API was dissolved in DMA at 150 mg/ml and added to the bulk solution, undissolved particles were observed prior to filtration and drug precipitation occurred in the bulk solution after overnight storage. When API was dissolved in DMA at 135 mg/ml and added to the bulk solution, the clear and colorless solution was obtained and remained stable after overnight storage. Therefore the API in DMA solution concentration was increased from 120 mg/ml in the last study to 135 mg/ml in the new formulation ID. The compositions of the other ingredients in Formulation ID remained the same as in Formulation IC and were described in Table 32.

TABLE 32

	Formulation ID
API (mg/mL)	0.125 (added as 135 mg/ml in DMA)
Excipients	Kleptose® (30 mg/mL)
Solvents	pH 4.3 citrate Buffer

The target pH value of the citrate buffer was adjusted from 4.5 to 4.3 to ensure more robust solution stability below pH 4.5. The subsequent HPLC tests confirmed that both the assay and the purity of the filtered bulk solution remained stable with no obvious degradation growth within 8 hours (data not shown). Therefore the recommended holding time for the bulk solution upon preparation is 8 hours at ambient condition.

In the lyophilization cycle, the shelf temperature and the chamber pressure of primary drying were elevated to -16°C . and 140 microns respectively to enhance the sublimation rate. The more aggressive process parameters reduced the primary drying time from over 100 hours in the previous study to about 60 hours. To add some safety margin, the final primary drying time was set at 70 hours. Secondary drying was processed at 50°C . and 140 microns for 12 hours. The cycle parameters are described in Table 33.

TABLE 33

Step	Shelf Temp. Setpoint ($^{\circ}\text{C}$.)	Soak Time (hours)	Ramping Rate ($^{\circ}\text{C}$./hour)	Pressure Setpoint
Product Loading/Freezing	5	2		Evac. To 12 psia to ensure chamber is airtight
Freezing	-50	3	30	
Primary Drying	-16	70	30	140 microns
Secondary Drying	50	12		140 microns
Stoppering	50			14.7 PSIA

The temperature profile of the lyophilization cycle is illustrated in FIG. 31.

Product break temperature ranges from -28°C . to -30°C . during primary drying suggesting that the product was dried with absence of collapse and there is still room to improve the primary drying rate in further development.

The finished product of Formulation ID showed dense and uniform cake appearance. The moisture content is below the detection limit of the Karl Fisher method. The residual DMA level dropped to 4.2 mg/vial, which was below the target upper limit of 5.45 mg/vial. The resulting assay value was unexpectedly high at 110.8%. Compounding the API in DMA by volume was identified to be the high risk step contributing to the high assay. It was suggested to compound by weight in lieu of volume in future studies. The reconstitution performance was comparable to previous Formulation IC samples. Overall, the results of the finished product testing were considered to be acceptable for the FIH clinical study.

Summary of Process Development

Five process studies were executed in series to investigate the impact of the critical process parameters on the quality of finished drug products, especially the residual solvent content. The refinement of the formulation was conducted concurrently with the process development. It was found that presence of cyclodextrin in the formulation led to entrapment of the residual DMA in the dried cake. Secondary drying had minimal impact on the removal of the residual DMA. Reducing initial DMA charge in the formulation and using more aggressive cycle parameters in primary drying helped to reduce the residual DMA. The formulation ID and the lyophilization process identified in the last process study were taken to the scale up demo batch for evaluation. A complete process diagram including compounding, freeze-drying, filtration, filling, and packaging was illustrated in FIG. 32.

Example 12

Stability of Finished Drug Products

Preliminary stability studies have been performed during the formulation screen. Among all the prototype formulations, Formulation IX composition is the closest to the FIH formulation. Formulation IC which was evaluated towards the end of the process development has exactly the same composition as the FIH formulation except for the residual solvent level. Table 34 compares the formulation compositions of IX and IC as opposed to the FIH formulation.

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TABLE 34

Lot No.	Formulation IX	Formulation IC	Formulation ID (FIH)
Form C (mg/vial)	0.76	1.0	1.0
Citric acid anhydrous, USP (mg/vial)	6.1	17.7	17.7
Sodium citrate anhydrous, USP (mg/vial)	8.2	17.6	17.6
Kleptose® HPB, parenteral grade (mg/vial)	67	240	240
TBA (in process media)	Removed upon drying	0	0
DMA, PW (in process media)*	Removed upon drying		
Total	82.1	276.3	276.3

The stability data of Formulation IX and Formulation IC is presented in Table 35.

TABLE 35

	Purity (% area)		Assay (% label claim)	
	Formulation No.			
	IX	IC	IX	IC
Initial	98.5	97.8	93.0	101.0
1 mo @ 40° C./75% RH	98.6	97.9	96.3	104.6
3 mo @ 40° C./75% RH	99.6	/	96.0	/
1 mo @ 25° C./60% RH	98.6	/	96.5	/
3 mo @ 25° C./60% RH	99.6	/	95.8	/

Formulation IX samples remained stable at the accelerated condition of 40° C./75% RH for three months with no obvious degradant growth. Similarly, Formulation IC samples remained stable at the accelerated condition of 40° C./75% RH for one month. The accelerated stability data obtained so far showed very promising results indicating that finished drug products could have an acceptable shelf life under room temperature storage condition.

Example 13

In-use Stability of Reconstituted Solutions

Reconstitution studies were conducted with either D5W or purified water with different volumes from 2 ml to 8 ml. Similar reconstitution performance was observed regardless of the type or the volume of the diluents. Osmolality measurement was conducted on each reconstituted solution and the results are shown in Table 36.

TABLE 36

	Diluent volume	
	2 ml	8 ml
D5W	636 ± 2 mOsm/kg	404 ± 1 mOsm/kg
Purified water	283 ± 0 mOsm/kg	72 ± 1 mOsm/kg
Water For Injection	301 ± 0 mOsm/kg	/

It was found that reconstitution with 2 ml purified water rendered an osmolality of 283 mOsm/kg. This value is very close to the human plasma osmolality of 285-295 mOsm/kg, while the other three reconstituted solutions exhibited very

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distinct osmolality values. Subsequently the same measurement was repeated with 2 ml water for injection (WFI) and the osmolality value of 301 mOsm/kg was obtained. As a result, 2 ml water for injection was recommended as the reconstitution diluent due to its physiologically isotonic characteristic and used in the following reconstitution studies to evaluate the in-use stability of the reconstituted solution. The assay and purity of the reconstituted solution were measured by HPLC every two hours for 8 hours. The results are shown in Table 37.

TABLE 37

Time Point	Assay (% LC)	Purity (% area)	Hydrolysis Degradant 1 (% area)	Hydrolysis Degradant 2 (% area)
T = 0	108.8	97.90	0.16	0.39
T = 2 hr	109.1	97.91	0.16	0.39
T = 4 hr	108.4	97.91	0.16	0.39
T = 6 hr	108.4	97.90	0.16	0.40
T = 8 hr	108.5	97.89	0.17	0.40

The in-use stability data demonstrated that the formulation solution upon reconstitution remained stable for 8 hours at room temperature condition. Meanwhile no drug precipitation was observed after overnight storage at room temperature condition by visual inspection, assuring the physical stability of the reconstituted solution.

Based on the aforementioned stability results, the proposed reconstitution procedures are described as follows:

Reconstitute each vial with 2 mL sterile water for injection. Gently shake or roll the vial until all solids are dissolved. The resulting solution will contain Form C 0.50 mg/mL. The solution should be clear and colorless. The reconstituted solution remains stable in the vial at room temperature for 8 hours. Inspect the solution visually for particulate matter and discoloration prior to administration. Withdraw the required amount of Form C solution to deliver the desired dose.

The embodiments described above are intended to be merely exemplary, and those skilled in the art will recognize, or will be able to ascertain using no more than routine experimentation, numerous equivalents of specific compounds, materials, and procedures. All such equivalents are considered to be within the scope of the invention and are encompassed by the appended claims.

Formulation of the invention are for use in medicine.

Formulations of the invention are for use in the methods of treatment provided herein.

What is claimed:

1. A lyophilized formulation comprising: Compound 1 (2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide), or a stereoisomer or mixture of stereoisomers, pharmaceutically acceptable salt, tautomer, prodrug, solvate, hydrate, co-crystal, clathrate, or polymorph thereof, a buffer and a bulking agent.

2. The lyophilized formulation of claim 1, wherein Compound 1 comprises a solid form of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide.

3. The lyophilized formulation of claim 1, wherein Compound 1 comprises an amorphous form of 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide.

4. The lyophilized formulation of claim 1, wherein Compound 1 is present in an amount from about 0.1 to about 2% based on the total weight of the lyophilized formulation.

5. The lyophilized formulation of claim 1, wherein Compound 1 is present from about 0.1 to about 1% based on the total weight of the lyophilized formulation.

6. The lyophilized formulation of claim 1, wherein Compound 1 is present in about 0.36% based on the total weight of the lyophilized formulation.

7. The lyophilized formulation of claim 1, wherein the buffer is a citrate buffer.

8. The lyophilized formulation of claim 7, wherein citrate buffer is present in an amount from about 5% to about 25% based on total weight of the lyophilized formulation.

9. The lyophilized formulation of claim 7, wherein citrate buffer comprises anhydrous citric acid and anhydrous sodium citrate.

10. The lyophilized formulation of claim 9, wherein anhydrous citric acid is present in an amount from about 2% to about 10% based on total weight of the lyophilized formulation.

11. The lyophilized formulation of claim 9, wherein anhydrous citric acid is present in an amount from about 5% to about 8% based on total weight of the lyophilized formulation.

12. The lyophilized formulation of claim 9, wherein anhydrous citric acid is present in an amount from about 6% to about 8% based on total weight of the lyophilized formulation.

13. The lyophilized formulation of claim 9, wherein anhydrous citric acid is present in an amount of about 6.41% based on total weight of the lyophilized formulation.

14. The lyophilized formulation of claim 9, wherein anhydrous sodium citrate is present in an amount from about 2% to about 15% based on total weight of the lyophilized formulation.

15. The lyophilized formulation of claim 9, wherein anhydrous sodium citrate is present in an amount from about 4% to about 10% based on total weight of the lyophilized formulation.

16. The lyophilized formulation of claim 14, wherein anhydrous sodium citrate is present in an amount of about 6.37% based on total weight of the lyophilized formulation.

17. The lyophilized formulation of claim 1, wherein the bulking agent is selected from mannitol, sulfobutylether- β -cyclodextrin, β -cyclodextrin, hydroxypropyl β -cyclodextrin and methylated β -cyclodextrin.

18. The lyophilized formulation of claim 1, wherein the bulking agent is hydroxypropyl β -cyclodextrin.

19. The lyophilized formulation of claim 1, wherein the bulking agent is present in an amount from about 70% to about 95% based on total weight of the lyophilized formulation.

20. The lyophilized formulation of claim 1, wherein the bulking agent is present in an amount from about 80% to about 90% based on total weight of the lyophilized formulation.

21. The lyophilized formulation of claim 18, wherein hydroxypropyl β -cyclodextrin is present in an amount from about 80% to about 90% based on total weight of the lyophilized formulation.

22. The lyophilized formulation of claim 18, wherein hydroxypropyl β -cyclodextrin is present in an amount of about 86.86% based on total weight of the lyophilized formulation.

23. The lyophilized formulation of claim 1, wherein Compound 1 is present from about 0.1 to about 1%, and the lyophilized formulation comprises anhydrous citric acid in an amount from about 6% to about 8%, anhydrous sodium citrate in an amount from about 4% to about 10% and the

bulking agent in an amount from about 70% to about 95% based on total weight of the lyophilized formulation.

24. The lyophilized formulation of claim 1, wherein Compound 1 in about 0.36%, and the lyophilized formulation comprises anhydrous citric acid in about 6.41%, anhydrous sodium citrate in about 6.37% and hydroxypropyl β -cyclodextrin in about 86.86% based on total weight of the lyophilized formulation.

25. A reconstituted formulation obtainable from the lyophilized formulation of claim 1 comprising a diluent.

26. The reconstituted formulation of claim 25, wherein the diluent is water.

27. The reconstituted formulation of claim 25, wherein Compound 1 is present in an amount of about 0.1 to 1 mg/mL.

28. The reconstituted aqueous formulation of claim 26, wherein Compound 1 is present in an amount of about 0.5 mg/mL.

29. The reconstituted aqueous formulation of claim 26, wherein the formulation has a pH in a range from about 4 to about 5.

30. The reconstituted aqueous formulation of claim 26, wherein the formulation has a pH of about 4.3.

31. A method of treating cancer comprising administering to a mammal having cancer the lyophilized formulation of claim 1.

32. The method of claim 31, wherein the cancer is leukemia.

33. The method of claim 32, wherein the leukemia is chronic lymphocytic leukemia, chronic myelocytic leukemia, acute lymphoblastic leukemia or acute myeloid leukemia.

34. The method of claim 32, wherein the leukemia is an acute myeloid leukemia.

35. The method of claim 34, wherein the leukemia is relapsed, refractory or resistant to conventional therapy.

36. The method of claim 31, further comprising administering a therapeutically effective amount of a second active agent or a support care therapy.

37. The method of claim 36, wherein the second active agent is 1) a therapeutic antibody that specifically binds to a cancer antigen or a pharmacologically active mutant thereof, 2) a hematopoietic growth factor, 3) a cytokine, 4) an anti-cancer agent, 5) an antibiotic, 6) a cox-2 inhibitor, 7) an immunomodulatory agent, 8) an immunosuppressive agent, or 9) a corticosteroid.

38. The method of claim 31, wherein the cancer is a hematologic malignancy.

39. The method of claim 38, wherein the hematologic malignancy is acute myelogenous leukemia, acute lymphocytic leukemia, adult T-cell leukemia, chronic lymphocytic leukemia, hairy cell leukemia, myelodysplasia, myeloproliferative disorders, chronic myelogenous leukemia, myelodysplastic syndrome, human lymphotropic virus-type 1 leukemia, mastocytosis, B-cell acute lymphoblastic leukemia, diffuse large B-cell lymphoma, B-cell immunoblastic lymphoma, small non-cleaved cell lymphoma, human lymphotropic virus-type 1 leukemia/lymphoma, adult T-cell lymphoma, peripheral T cell lymphoma (PTCL), cutaneous T-cell lymphoma, mantle cell lymphoma, Hodgkin lymphoma, non-Hodgkin lymphoma, AIDS-related lymphoma, follicular lymphoma, small lymphocytic lymphoma, T-cell/histiocyte rich large B-cell lymphoma, transformed lymphoma, primary mediastinal large B-cell lymphoma, splenic marginal zone lymphoma, Richter's transformation, nodal marginal zone lymphoma, or ALK-positive large B-cell lymphoma.

40. The method of claim 31, wherein the cancer is a solid tumor.

41. The method of claim 31, wherein the cancer is a cancer of bladder, bone, blood, brain, breast, cervix, chest, colon, endometrium, esophagus, eye, head, kidney, liver, lymph nodes, lung, mouth, neck, ovaries, pancreas, prostate, rectum, stomach, testis, throat, or uterus.

42. A method of treating cancer comprising administering to a mammal having cancer the formulation of claim 25.

43. The method of claim 32, wherein the method comprises administering the formulation intravenously.

44. The method of claim 42, wherein the cancer is leukemia.

45. The method of claim 44, wherein the leukemia is chronic lymphocytic leukemia, chronic myelocytic leukemia, acute lymphoblastic leukemia or acute myeloid leukemia.

46. The method of claim 44, wherein the leukemia is an acute myeloid leukemia.

47. The method of claim 46, wherein the leukemia is relapsed, refractory or resistant to conventional therapy.

48. The method of claim 42, further comprising administering a therapeutically effective amount of a second active agent or a support care therapy.

49. The method of claim 48, wherein the second active agent is 1) a therapeutic antibody that specifically binds to a cancer antigen or a pharmacologically active mutant thereof, 2) a hematopoietic growth factor, 3) a cytokine, 4) an anti-cancer agent, 5) an antibiotic, 6) a cox-2 inhibitor, 7) an immunomodulatory agent, 8) an immunosuppressive agent, or 9) a corticosteroid.

50. A process for preparing a lyophilized formulation, comprising: dissolving a bulking agent and 2-(4-chlorophenyl)-N-((2-(2,6-dioxopiperidin-3-yl)-1-oxoisindolin-5-yl)methyl)-2,2-difluoroacetamide, or a stereoisomer or mixture of stereoisomers, pharmaceutically acceptable salt, tautomer, prodrug, solvate, hydrate, co-crystal, clathrate, or polymorph thereof in a buffer solution to produce a solution; and lyophilizing the resulting solution to produce a powder.

* * * * *

TABLA DE CORRESPONDENCIA ENTRE LAS REIVINDICACIONES CONCEDIDAS POR LA OFICINA DE MARCAS Y PATENTES DE ESTADOS UNIDOS (UPSTO) Y LAS REIVINDICACIONES ACTUALMENTE PRESENTADAS EN COLOMBIA ANTE LA SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO (SIC)

Reivindicaciones Concedidas por la Oficina de Marcas y Patentes de Estados Unidos (UPSTO)	Reivindicaciones modificadas en COLOMBIA el 4 de abril de 2019	Explicación de la correspondencia
1. Una formulación liofilizada que comprende: El Compuesto 1 (2-(4-clorofenil)-N-((2-(2,6-dioxopiperidin-3-il)-1-oxoisindolin-5-il)metil)-2,2-difluoroacetamida) o un estereoisómero o mezcla de estereoisómeros, una sal farmacéuticamente aceptable, tautómero, profármaco, solvato, hidrato, cocrystal, clatrato o polimorfo de estos, un amortiguador y un agente espesante.	1. Una formulación liofilizada que comprende: El Compuesto 1 (2-(4-clorofenil)-N-((2-(2,6-dioxopiperidin-3-il)-1-oxoisindolin-5-il)metil)-2,2-difluoroacetamida) o un estereoisómero o mezcla de estereoisómeros, una sal farmacéuticamente aceptable, tautómero, profármaco, solvato, hidrato, cocrystal, clatrato o polimorfo de estos, un amortiguador y un agente espesante.	Las reivindicaciones actualmente presentadas ante la SIC son exactamente iguales a las concedidas por la USPTO
2. La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 comprende una forma sólida de 2-(4-clorofenil)-N-((2-(2,6-dioxopiperidin-3-il)-1-oxoisindolin-5-il)metil)-2,2-difluoroacetamida.	2. La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 comprende una forma sólida de 2-(4-clorofenil)-N-((2-(2,6-dioxopiperidin-3-il)-1-oxoisindolin-5-il)metil)-2,2-difluoroacetamida.	

3. La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 comprende una forma amorfa de 2-(4-clorofenil)-N-((2-(2,6-dioxopiperidin-3-il)-1-oxoisoindolin-5-il)metil)-2,2-difluoroacetamida.	3. La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 comprende una forma amorfa de 2-(4-clorofenil)-N-((2-(2,6-dioxopiperidin-3-il)-1-oxoisoindolin-5-il)metil)-2,2-difluoroacetamida.	
4. La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 se encuentra presente en una cantidad de alrededor de 0.1 a alrededor de 2 % según el peso total de la formulación liofilizada.	4. La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 se encuentra presente en una cantidad de alrededor de 0.1 a alrededor de 2 % según el peso total de la formulación liofilizada.	
5. La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 se encuentra presente de alrededor de 0.1 a alrededor de 1% según el peso total de la formulación liofilizada.	5. La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 se encuentra presente de alrededor de 0.1 a alrededor de 1% según el peso total de la formulación liofilizada.	
6. La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 se encuentra presente en alrededor de 0.36 % según el peso total de la formulación liofilizada.	6. La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 se encuentra presente en alrededor de 0.36 % según el peso total de la formulación liofilizada.	

7. La formulación liofilizada de la reivindicación 1, en donde el amortiguador es un amortiguador de citrato.	7. La formulación liofilizada de la reivindicación 1, en donde el amortiguador es un amortiguador de citrato.	
8. La formulación liofilizada de la reivindicación 7, en donde el amortiguador de citrato se encuentra presente en una cantidad de alrededor de 5 % a alrededor de 25 % según el peso total de la formulación liofilizada.	8. La formulación liofilizada de la reivindicación 7, en donde el amortiguador de citrato se encuentra presente en una cantidad de alrededor de 5 % a alrededor de 25 % según el peso total de la formulación liofilizada.	
9. La formulación liofilizada de la reivindicación 7, en donde el amortiguador de citrato comprende ácido cítrico anhidro y citrato de sodio anhidro.	9. La formulación liofilizada de la reivindicación 7, en donde el amortiguador de citrato comprende ácido cítrico anhidro y citrato de sodio anhidro.	
10. La formulación liofilizada de la reivindicación 9, en donde el ácido cítrico anhidro se encuentra presente en una cantidad de alrededor de 2% a alrededor de 10% según el peso total de la formulación liofilizada.	10. La formulación liofilizada de la reivindicación 9, en donde el ácido cítrico anhidro se encuentra presente en una cantidad de alrededor de 2% a alrededor de 10% según el peso total de la formulación liofilizada.	

11. La formulación liofilizada de la reivindicación 9, en donde el ácido cítrico anhidro se encuentra presente en una cantidad de alrededor de 5 % a alrededor de 8 % según el peso total de la formulación liofilizada.	11. La formulación liofilizada de la reivindicación 9, en donde el ácido cítrico anhidro se encuentra presente en una cantidad de alrededor de 5 % a alrededor de 8 % según el peso total de la formulación liofilizada.	
12. La formulación liofilizada de la reivindicación 9, en donde el ácido cítrico anhidro se encuentra presente en una cantidad de alrededor de 6 % a alrededor de 8 % según el peso total de la formulación liofilizada.	12. La formulación liofilizada de la reivindicación 9, en donde el ácido cítrico anhidro se encuentra presente en una cantidad de alrededor de 6 % a alrededor de 8 % según el peso total de la formulación liofilizada.	
13. La formulación liofilizada de la reivindicación 9, en donde el ácido cítrico anhidro se encuentra presente en una cantidad de alrededor de 6.41 % según el peso total de la formulación liofilizada.	13. La formulación liofilizada de la reivindicación 9, en donde el ácido cítrico anhidro se encuentra presente en una cantidad de alrededor de 6.41 % según el peso total de la formulación liofilizada.	
14. La formulación liofilizada de la reivindicación 9, en donde el citrato de sodio anhidro se encuentra presente en una cantidad de alrededor de 2 % a	14. La formulación liofilizada de la reivindicación 9, en donde el citrato de sodio anhidro se encuentra presente en una cantidad de alrededor de 2 % a	

alrededor de 15 % según el peso total de la formulación liofilizada.	alrededor de 15 % según el peso total de la formulación liofilizada.	
15. La formulación liofilizada de la reivindicación 9, en donde el citrato de sodio anhidro se encuentra presente en una cantidad de alrededor de 4 % a alrededor de 10 % según el peso total de la formulación liofilizada.	15. La formulación liofilizada de la reivindicación 9, en donde el citrato de sodio anhidro se encuentra presente en una cantidad de alrededor de 4 % a alrededor de 10 % según el peso total de la formulación liofilizada.	
16. La formulación liofilizada de la reivindicación 14, en donde el citrato de sodio anhidro se encuentra presente en una cantidad de alrededor de 6.37 % según el peso total de la formulación liofilizada.	16. La formulación liofilizada de la reivindicación 14, en donde el citrato de sodio anhidro se encuentra presente en una cantidad de alrededor de 6.37 % según el peso total de la formulación liofilizada.	
17. La formulación liofilizada de la reivindicación 1, en donde el agente espesante se selecciona de manitol, sulfobutiléter- β -ciclodextrina, β -ciclodextrina, hidroxipropil β -ciclodextrina y β -ciclodextrina metilada.	17. La formulación liofilizada de la reivindicación 1, en donde el agente espesante se selecciona de manitol, sulfobutiléter- β -ciclodextrina, β -ciclodextrina, hidroxipropil β -ciclodextrina y β -ciclodextrina metilada.	

18. La formulación liofilizada de la reivindicación 1, en donde el agente espesante es hidroxipropil β -ciclodextrina.	18. La formulación liofilizada de la reivindicación 1, en donde el agente espesante es hidroxipropil β -ciclodextrina.	
19. La formulación liofilizada de la reivindicación 1, en donde el agente espesante se encuentra presente en una cantidad de alrededor de 70 % a alrededor de 95 % según el peso total de la formulación liofilizada.	19. La formulación liofilizada de la reivindicación 1, en donde el agente espesante se encuentra presente en una cantidad de alrededor de 70 % a alrededor de 95 % según el peso total de la formulación liofilizada.	
20. La formulación liofilizada de la reivindicación 1, en donde el agente espesante se encuentra presente en una cantidad de alrededor de 80% a alrededor de 90% según el peso total de la formulación liofilizada.	20. La formulación liofilizada de la reivindicación 1, en donde el agente espesante se encuentra presente en una cantidad de alrededor de 80% a alrededor de 90% según el peso total de la formulación liofilizada.	
21. La formulación liofilizada de la reivindicación 18, en donde hidroxipropil β -ciclodextrina se encuentra presente en una cantidad de alrededor de 80 % a alrededor de 90 % según el peso total de la	21. La formulación liofilizada de la reivindicación 18, en donde hidroxipropil β -ciclodextrina se encuentra presente en una cantidad de alrededor de 80 % a	

formulación liofilizada.	alrededor de 90 % según el peso total de la formulación liofilizada.	
22. La formulación liofilizada de la reivindicación 18, en donde hidroxipropil β -ciclodextrina se encuentra presente en una cantidad de alrededor de 86.86 % según el peso total de la formulación liofilizada.	22. La formulación liofilizada de la reivindicación 18, en donde hidroxipropil β -ciclodextrina se encuentra presente en una cantidad de alrededor de 86.86 % según el peso total de la formulación liofilizada.	
23. La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 se encuentra presente de alrededor de 0.1 a alrededor de 1 %, y la formulación liofilizada comprende el ácido cítrico anhidro en una cantidad de alrededor de 6 % a alrededor de 8 %, el citrato de sodio anhidro en una cantidad de alrededor de 4 % a alrededor de 10 % y el agente espesante en una cantidad de alrededor de 70 % a alrededor de 95 % según el peso total de la formulación liofilizada.	23. La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 se encuentra presente de alrededor de 0.1 a alrededor de 1 %, y la formulación liofilizada comprende el ácido cítrico anhidro en una cantidad de alrededor de 6 % a alrededor de 8 %, el citrato de sodio anhidro en una cantidad de alrededor de 4 % a alrededor de 10 % y el agente espesante en una cantidad de alrededor de 70 % a alrededor de 95 % según el peso total de la formulación liofilizada.	
24. La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 se encuentra presente en	24. La formulación liofilizada de la reivindicación 1, en donde el Compuesto 1 se encuentra presente en	

alrededor de 0.36 %, y la formulación liofilizada comprende ácido cítrico anhidro en alrededor de 6.41 %, citrato de sodio anhidro en alrededor de 6.37 % y la hidroxipropil β-ciclodextrina en alrededor de 86.86 % según el peso total de la formulación liofilizada.	alrededor de 0.36 %, y la formulación liofilizada comprende ácido cítrico anhidro en alrededor de 6.41 %, citrato de sodio anhidro en alrededor de 6.37 % y la hidroxipropil β-ciclodextrina en alrededor de 86.86 % según el peso total de la formulación liofilizada.	
25. Una formulación reconstituida que se puede obtener a partir de la formulación liofilizada de la reivindicación 1 que comprende un diluyente.	25. Una formulación reconstituida que se puede obtener a partir de la formulación liofilizada de la reivindicación 1 que comprende un diluyente.	
26. La formulación reconstituida de la reivindicación 25, en donde el diluyente es agua.	26. La formulación reconstituida de la reivindicación 25, en donde el diluyente es agua.	
27. La formulación reconstituida de la reivindicación 25, en donde el Compuesto 1 se encuentra presente en una cantidad de alrededor de 0.1 a 1 mg/mL.	27. La formulación reconstituida de la reivindicación 25, en donde el Compuesto 1 se encuentra presente en una cantidad de alrededor de 0.1 a 1 mg/mL.	
28. La formulación acuosa reconstituida de la reivindicación 26, en donde el Compuesto 1 se	28. La formulación acuosa reconstituida de la reivindicación 26, en donde el Compuesto 1 se	

encuentra presente en una cantidad de alrededor de 0.5 mg/mL.	encuentra presente en una cantidad de alrededor de 0.5 mg/mL.	
29. La formulación acuosa reconstituida de la reivindicación 26, en donde la formulación tiene un pH en un intervalo de alrededor de 4 a alrededor de 5.	29. La formulación acuosa reconstituida de la reivindicación 26, en donde la formulación tiene un pH en un intervalo de alrededor de 4 a alrededor de 5.	
30. La formulación acuosa reconstituida de la reivindicación 26, en donde la formulación tiene un pH de alrededor de 4.3.	30. La formulación acuosa reconstituida de la reivindicación 26, en donde la formulación tiene un pH de alrededor de 4.3.	
31. Un método para tratar el cáncer que comprende la administración a un mamífero que tiene cáncer la formulación liofilizada de la reivindicación 1.	31. Un método para tratar el cáncer que comprende la administración a un mamífero que tiene cáncer la formulación liofilizada de la reivindicación 1.	
32. El método de la reivindicación 31, en donde el cáncer es leucemia.	32. El método de la reivindicación 31, en donde el cáncer es leucemia.	
33. El método de la reivindicación 32, en donde la leucemia es leucemia linfocítica crónica, leucemia	33. El método de la reivindicación 32, en donde la leucemia es leucemia linfocítica crónica, leucemia	

mielocítica crónica, leucemia linfoblástica aguda o leucemia mieloide aguda.	mielocítica crónica, leucemia linfoblástica aguda o leucemia mieloide aguda.	
34. El método de la reivindicación 32, en donde la leucemia es una leucemia mieloide aguda.	34. El método de la reivindicación 32, en donde la leucemia es una leucemia mieloide aguda.	
35. El método de la reivindicación 34, en donde la leucemia es recidivante, refractaria o resistente a la terapia convencional.	35. El método de la reivindicación 34, en donde la leucemia es recidivante, refractaria o resistente a la terapia convencional.	
36. El método de la reivindicación 31, que comprende además la administración de una cantidad terapéuticamente eficaz de un agente activo secundario o una terapia de cuidados complementarios.	36. El método de la reivindicación 31, que comprende además la administración de una cantidad terapéuticamente eficaz de un agente activo secundario o una terapia de cuidados complementarios.	
37. El método de la reivindicación 36, en donde el agente activo secundario es 1) un anticuerpo terapéutico que se une específicamente a un antígeno de cáncer o una mutación farmacológicamente activa del mismo, 2) un factor	37. El método de la reivindicación 36, en donde el agente activo secundario es 1) un anticuerpo terapéutico que se une específicamente a un antígeno de cáncer o una mutación farmacológicamente activa del mismo, 2) un factor de	

de crecimiento hematopoyético, 3) una citocina, 4) un agente contra el cáncer, 5) un antibiótico, 6) un inhibidor cox-2, 7) un agente inmunomodulador, 8) un agente inmunosupresor, o 9) un corticosteroide.	crecimiento hematopoyético, 3) una citocina, 4) un agente contra el cáncer, 5) un antibiótico, 6) un inhibidor cox-2, 7) un agente inmunomodulador, 8) un agente inmunosupresor, o 9) un corticosteroide.	
38. Un método para tratar el cáncer que comprende la administración a un mamífero que tiene cáncer la formulación de la reivindicación 25.	38. Un método para tratar el cáncer que comprende la administración a un mamífero que tiene cáncer la formulación de la reivindicación 25.	
39. El método de la reivindicación 32, en donde el método comprende la administración intravenosa de la formulación.	39. El método de la reivindicación 32, en donde el método comprende la administración intravenosa de la formulación.	
40. El método de la reivindicación 38, en donde el cáncer es leucemia.	40. El método de la reivindicación 38, en donde el cáncer es leucemia.	
41. El método de la reivindicación 40, en donde la leucemia es leucemia linfocítica crónica, leucemia mielocítica crónica, leucemia linfoblástica aguda o	41. El método de la reivindicación 40, en donde la leucemia es leucemia linfocítica crónica, leucemia	

leucemia mieloide aguda.	mielocítica crónica, leucemia linfoblástica aguda o leucemia mieloide aguda.	
42. El método de la reivindicación 40, en donde la leucemia es una leucemia mieloide aguda.	42. El método de la reivindicación 40, en donde la leucemia es una leucemia mieloide aguda.	
43. El método de la reivindicación 42, en donde la leucemia es recidivante, refractaria o resistente a la terapia convencional.	43. El método de la reivindicación 42, en donde la leucemia es recidivante, refractaria o resistente a la terapia convencional.	
44. El método de la reivindicación 38, que comprende además la administración de una cantidad terapéuticamente eficaz de un agente activo secundario__o una terapia de cuidados complementarios.	44. El método de la reivindicación 38, que comprende además la administración de una cantidad terapéuticamente eficaz de un agente activo secundario o una terapia de cuidados complementarios.	
45. El método de la reivindicación 44 en donde el agente activo secundario es 1) un anticuerpo terapéutico que se une específicamente a un antígeno de cáncer o una mutación farmacológicamente activa del mismo, 2) un factor	45. El método de la reivindicación 44 en donde el agente activo secundario es 1) un anticuerpo terapéutico que se une específicamente a un antígeno de cáncer o una mutación farmacológicamente activa del mismo, 2) un factor de	

de crecimiento hematopoyético, 3) una citocina, 4) un agente contra el cáncer, 5) un antibiótico, 6) un inhibidor cox-2, 7) un agente inmunomodulador, 8) un agente inmunosupresor, o 9) un corticosteroide.	crecimiento hematopoyético, 3) una citocina, 4) un agente contra el cáncer, 5) un antibiótico, 6) un inhibidor cox-2, 7) un agente inmunomodulador, 8) un agente inmunosupresor, o 9) un corticosteroide.	
46. Un proceso para preparar una formulación liofilizada, que comprende: disolver un agente espesante y 2-(4-clorofenil)-N-((2-(2,6-dioxopiperidin-3-il)-1-oxoisindolin-5-il)metil)-2,2-difluoroacetamida, o un estereoisómero o mezcla de estereoisómeros, sal farmacéuticamente aceptable, tautómero, profármaco, solvato, hidrato, co-cristal, clatrato o polimorfo de estos en una solución amortiguadora para producir una solución; y liofilizar la solución resultante para producir un polvo.	46. Un proceso para preparar una formulación liofilizada, que comprende: disolver un agente espesante y 2-(4-clorofenil)-N-((2-(2,6-dioxopiperidin-3-il)-1-oxoisindolin-5-il)metil)-2,2-difluoroacetamida, o un estereoisómero o mezcla de estereoisómeros, sal farmacéuticamente aceptable, tautómero, profármaco, solvato, hidrato, co-cristal, clatrato o polimorfo de estos en una solución amortiguadora para producir una solución; y liofilizar la solución resultante para producir un polvo.	
47. El método de la reivindicación 31, en donde el cáncer es una malignidad hematológica.	47. El método de la reivindicación 31, en donde el cáncer es una malignidad hematológica.	
48. El método de la reivindicación 47, en donde la malignidad hematológica es leucemia mielógena	48. El método de la reivindicación 47, en donde la malignidad hematológica es leucemia mielógena	

aguda, leucemia linfocítica aguda, leucemia de linfocitos T en adultos, leucemia linfocítica crónica, leucemia de células pilosas, mielodisplasia, trastorno mieloproliferativo, leucemia mielógena crónica, síndrome mielodisplásico, leucemia tipo 1 del virus linfotrópico humana, mastocitosis o leucemia linfoblástica aguda de células B, linfoma difuso de células B grandes, linfoma inmunoblástico de linfocitos B, linfoma de células pequeñas no hendidas, leucemia/linfoma tipo 1 del virus linfotrópico humano, linfoma de linfocitos T en adultos, linfoma de células T periféricos (PTCL), linfoma cutáneo de células T, linfoma de células del manto, linfoma de Hodgkin, linfoma no Hodgkin, linfoma relacionado con células-T/histiocitos, linfoma transformado, linfoma de células B grandes mediastinal primario, linfoma de la zona marginal esplénica, transformación de Richter, linfoma de la zona marginal nodal o linfoma de células B grandes positivo para ALK.	aguda, leucemia linfocítica aguda, leucemia de linfocitos T en adultos, leucemia linfocítica crónica, leucemia de células pilosas, mielodisplasia, trastorno mieloproliferativo, leucemia mielógena crónica, síndrome mielodisplásico, leucemia tipo 1 del virus linfotrópico humana, mastocitosis o leucemia linfoblástica aguda de células B, linfoma difuso de células B grandes, linfoma inmunoblástico de linfocitos B, linfoma de células pequeñas no hendidas, leucemia/linfoma tipo 1 del virus linfotrópico humano, linfoma de linfocitos T en adultos, linfoma de células T periféricos (PTCL), linfoma cutáneo de células T, linfoma de células del manto, linfoma de Hodgkin, linfoma no Hodgkin, linfoma relacionado con células-T/histiocitos, linfoma transformado, linfoma de células B grandes mediastinal primario, linfoma de la zona marginal esplénica, transformación de Richter, linfoma de la zona marginal nodal o linfoma de células B grandes positivo para ALK.	
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49. El método de la reivindicación 31, en donde el cáncer es un tumor sólido.	49. El método de la reivindicación 31, en donde el cáncer es un tumor sólido.	
50. El método de la reivindicación 31, en donde el cáncer es un cáncer de cánceres de la vejiga, de hueso, de sangre, cerebro, mama, cuello de útero, pecho, colon, endometrio, esófago, ojo, cabeza, riñón, hígado, ganglios linfáticos, pulmón, boca, cuello, ovarios, páncreas, próstata, recto, estómago, testículos, garganta y útero.	50. El método de la reivindicación 31, en donde el cáncer es un cáncer de cánceres de la vejiga, de hueso, de sangre, cerebro, mama, cuello de útero, pecho, colon, endometrio, esófago, ojo, cabeza, riñón, hígado, ganglios linfáticos, pulmón, boca, cuello, ovarios, páncreas, próstata, recto, estómago, testículos, garganta y útero.	

	Espacio reservado para el adhesivo de radicación
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AS. 142.219

DIRECCIÓN DE NUEVAS CREACIONES
Procedimiento acelerado de exámenes de patente (PPH)

1	NÚMERO DE SOLICITUD ANTE LA SIC	NC2018/0008305		
2	OFICINA DE PRIMERA PRESENTACIÓN (OPP)	USPTO		
3	NÚMERO(S) DE SOLICITUD O PUBLICACIÓN DE LA(S) SOLICITUD(ES) (OPP):	1. 15/400,791 2. 3.		
4	☐ REPRESENTANTE LEGAL ☒ APODERADO			
APELLIDOS CADENA SARMIENTO		NOMBRES JUAN PABLO		IDENTIFICACIÓN C.C. 80.410.337 T.P. 57492
DIRECCIÓN Calle 70 Bis 4 41		No. TELÉFONO 7442200		
CIUDAD Bogotá, D.C.		CORREO ELECTRÓNICO notificaciones@bc.com.co		
PAÍS CO		No. RADICACIÓN O PROTOCOLO DE PODER GENERAL		
5	CONDICIONES PARA ACCEDER A ESTE PROCESO:			
5.1. DATOS DE PRIORIDAD ☒ SI ☐ NO				
(33) PAÍS DE ORIGEN 1. US 2. 3. 4.		CÓDIGO PAÍS US	(31) NÚMERO 62/276,756	(32) FECHA (AAAA/MM/DD) 2016/01/08
5.2. DATOS SOLICITUD INTERNACIONAL PCT ☒ SI ☐ NO				
Solicitud Internacional No.		PCT/US2017/012483		Fecha 2017.01.06
Publicación Internacional No.		WO 2017/120437		Fecha 2017.07.13
El solicitante presenta una copia de la(s) reivindicación(es) patentable(s) u otorgable(s) de la solicitud de la Oficina de Primera Presentación que profirió el examen de patentabilidad, junto con una traducción al castellano. ☒ SI ☐ NO				
REQUISITOS PARA EL RECONOCIMIENTO DE LOS RESULTADOS DE EXÁMENES DE PATENTABILIDAD EFECTUADOS A SOLICITUDES EXTRANJERAS				
Para que la Superintendencia de Industria y Comercio pueda reconocer los resultados de exámenes de patentabilidad producidos por otras Oficinas de Propiedad Industrial se debe cumplir con las siguientes condiciones:				
(a) Al momento de solicitar el examen de patentabilidad, si el solicitante pide que se reconozcan exámenes de patentabilidad de otras oficinas extranjeras, deberá aportar junto con el pago de la tasa correspondiente, los siguientes anexos:				
(i) Copia de las resoluciones, fallos o decisiones que han sido relevantes para la determinación de la patentabilidad de la(s) solicitud(es) en la Oficina que haya proferido el examen de patentabilidad que contienen reivindicaciones patentables u otorgables que son la base de la petición, y si es del caso, su traducción al castellano. ☒ SI ☐ NO				
(ii) Copia de todas las reivindicaciones determinadas como patentables u otorgables en la Oficina que profirió el examen de patentabilidad y, si es del caso, su traducción al castellano. ☒ SI ☐ NO				
(iii) Copia de los antecedentes, información o documentos citados por el examinador de la Oficina de Primera Presentación del examen de patentabilidad, en las resoluciones, fallos o decisiones correspondientes, incluyendo la literatura no patente. Los documentos de patente deberán presentarse siempre y cuando no estén disponibles para la Superintendencia de Industria y Comercio mediante el simple acceso a bases de datos gratuitas. ☐ SI ☒ NO				
(iv) Una tabla de correspondencias de las reivindicaciones que han sido determinadas como patentables u otorgables en la solicitud de la Oficina que haya proferido el examen de patentabilidad.				
7	FIRMA DEL SOLICITANTE, DEL APODERADO O DEL REPRESENTANTE LEGAL <i>Junto a cada firma, indicar el nombre del firmante y su calidad (si tal calidad no es obvia al leer el petitorio)</i>			