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Your Reference:	PD036182PCT	
Applicant:	NAIR, Hariharan Krishnan	
Number of Applicants:	1	
Title:	BARRIER FILM AND IMPLEMENTATIONS THEREOF	
Documents Submitted:	PD036182PCT-appb-000001.pdf (PD036182PCT_DESCRIPTION.pdf)	355075
	PD036182PCT-appb-000002.pdf (PD036182PCT_CLAIMS.pdf)	131722
	PD036182PCT-appb-000003.pdf (PD036182PCT_ABSTRACT.pdf)	113929
	PD036182PCT-appb-000004.pdf (PD036182PCT_DRAWINGS.pdf)	477536
	PD036182PCT-appb.xml	883
	PD036182PCT-decl.xml	2762
	PD036182PCT-fees.xml	1685
	PD036182PCT-poa-000001.xml	4532
	PD036182PCT-requ.xml	8098
	PD036182PCT-vlog.xml	748
Submitted by:	Malathi Lakshmikumar (Customer ID: user_IN_LAKSHMIKUMARAN_MALATHI_0262)	
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0	For receiving Office use only	
0-1	International Application No.	
0-2	International Filing Date	
0-3	Name of receiving Office and "PCT International Application"	
0-4	Form PCT/RO/101 PCT Request	
0-4-1	Prepared Using	ePCT-Filing Version 4.7.004 MT/FOP 20200527/1.1
0-5	Petition	
	The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	Indian Patent Office (RO/IN)
0-7	Applicant's or agent's file reference	PD036182PCT
I	Title of Invention	BARRIER FILM AND IMPLEMENTATIONS THEREOF
II	Applicant	
II-1	This person is	Applicant and inventor
II-2	Applicant for	All designated States
II-4	Name (LAST, First)	NAIR, Hariharan Krishnan
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II-6	State of nationality	IN
II-7	State of residence	IN
II-10	e-mail	iprdel@lakshmisri.com
II-10(a)	E-mail authorization The receiving Office, the International Searching Authority, the International Bureau and the International Preliminary Examining Authority are authorized to use this e-mail address, if the Office or Authority so wishes, to send notifications issued in respect of this international application:	exclusively in electronic form (no paper notifications will be sent)
III-1	Applicant and/or inventor	
III-1-1	This person is	Inventor only
III-1-3	Inventor for	All designated States
III-1-4	Name (LAST, First)	POZHAL VENGU, Gurunath
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IV-1	Agent or common representative; or address for correspondence The person identified below is hereby/ has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	Agent
IV-1-1	Name (LAST, First)	LAKSHMIKUMARAN, Malathi
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IV-1-5(a)	E-mail authorization The receiving Office, the International Searching Authority, the International Bureau and the International Preliminary Examining Authority are authorized to use this e-mail address, if the Office or Authority so wishes, to send notifications issued in respect of this international application:	as advance copies followed by paper notifications
IV-1-6	Agent's registration No.	IN/PA-1433
IV-2	Additional agent(s)	additional agent(s) with same address as first named agent
IV-2-1	Name(s)	RAE, Konpal(IN/PA-1228); PHILLIPS, Prashant(IN/PA-1229); PANDEYA, Jaya(IN/PA-1345); SRINIVASAN, T.(IN/PA-507)
V	DESIGNATIONS	
V-1	The filing of this request constitutes under Rule 4.9(a), the designation of all Contracting States bound by the PCT on the international filing date, for the grant of every kind of protection available and, where applicable, for the grant of both regional and national patents.	
VI-1	Priority claim of earlier national application	
VI-1-1	Filing date	13 December 2019 (13.12.2019)
VI-1-2	Number	201921051881
VI-1-3	Country or Member of WTO	IN
VI-2	Priority document request The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s):	VI-1
VI-3	Incorporation by reference : where an element of the international application referred to in Article 11(1)(iii)(d) or (e) or a part of the description, claims or drawings referred to in Rule 20.5(a) is not otherwise contained in this international application but is completely contained in an earlier application whose priority is claimed on the date on which one or more elements referred to in Article 11(1)(iii) were first received by the receiving Office, that element or part is, subject to confirmation under Rule 20.6, incorporated by reference in this international application for the purposes of Rule 20.6.	
VII-1	International Searching Authority Chosen	Indian Patent Office (ISA/IN)

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VIII	Declarations	Number of declarations	
VIII-1	Declaration as to the identity of the inventor	-	
VIII-2	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	-	
VIII-3	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	-	
VIII-4	Declaration of inventorship (only for the purposes of the designation of the United States of America)	1	
VIII-5	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	-	

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VIII-4-1	Declaration: Inventorship (only for the purposes of the designation of the United States of America) Declaration of Inventorship (Rules 4.17(iv) and 51bis.1(a)(iv)) for the purposes of the designation of the United States of America:	I hereby declare that I believe I am the original inventor or an original joint inventor of a claimed invention in the application. This declaration is directed to the international application of which it forms a part. I hereby declare that the above-identified international application was made or authorized to be made by me. I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.
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VIII-4-1-1-4	Inventor's Signature: (The signature must be that of the inventor, not that of the agent)	/Hariharan Krishnan NAIR/
VIII-4-1-1-5	Date:	16 June 2020 (16.06.2020)
VIII-4-1-2-1	Name (LAST, First)	POZHAL VENGU, Gurunath
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VIII-4-1-2-5	Date:	16 June 2020 (16.06.2020)

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IX	Check list	Number of sheets	Electronic file(s) attached
IX-1	Request (including declaration sheets)	5	✓
IX-2	Description	37	✓
IX-3	Claims	3	✓
IX-4	Abstract	1	✓
IX-5	Drawings	2	✓
IX-6a	Sequence listing part of the description (also to be used for the purposes of international search)	-	-
IX-7	TOTAL	48	
Accompanying Items		Paper document(s) attached	Electronic file(s) attached
IX-8	Fee calculation sheet	-	✓
IX-9	Original separate power of attorney	-	✓
IX-20	Figure of the drawings which should accompany the abstract	Figure 0	
IX-21	Language of filing of the international application	English	
X-1	Signature of applicant, agent or common representative	/Malathi Lakshmikumaran/	
X-1-1	Name (LAST, First)	LAKSHMIKUMARAN, Malathi	
X-1-3	Capacity (if such capacity is not obvious from reading the request)	Agent	

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10-1	Date of actual receipt of the purported international application	
10-2	Drawings:	
10-2-1	Received	
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/IN
10-6	Transmittal of search copy delayed until search fee is paid	

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11-1	Date of receipt of the record copy by the International Bureau	
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BARRIER FILM AND IMPLEMENTATIONS THEREOF

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to a barrier film for packaging comprising multi-layers. It also relates to a process of manufacturing such a multilayer barrier film, a
5 laminate comprising the barrier film, and a process of preparing the laminate. It further relates to an article comprising the barrier film or the laminate. Furthermore, the present invention relates to the use of the barrier film or the laminate in an article/packaging material.

BACKGROUND OF THE INVENTION

10 **[0002]** Packaging is an essential part of a product in today's developing world. Barrier property of packaging material is one of the critical properties for achieving product stability. Typically, various materials like aluminium, nylon, ethylene vinyl alcohol (EVOH), polyvinyl alcohol (PVOH), polyethylene terephthalate (PET), aluminium oxide, silicon oxide, etc. are used as barrier layers in food packaging applications.

15 **[0003]** The multilayer packaging films often comprise an oxygen barrier layer, which is typically a core layer positioned between at least two other layers. EVOH is among the preferable barrier material because of its low oxygen permeability, effective barrier to odors, fragrances, solvents, and oils and is therefore used as a component in the barrier film to improve its barrier properties. The barrier properties of EVOH depend
20 on various parameters like the percentage of ethylene, actual thickness of the barrier layer, relative humidity etc.

[0004] EVOH exhibits very good barrier properties to oxygen. Additionally, to improve the processability while maintaining desirable levels of oxygen barrier properties, EVOH barrier layers can be placed in contact with additional layers of
25 polyamides.

[0005] Multilayer films comprising one or more polyamide layers in contact with an EVOH barrier layer can provide improved impact resistance, flex crack resistance, or

drawability to the multilayer film. For example, US 6,068,933 and US6,562,476 disclose multilayer films comprising two nylon layers in contact with an EVOH barrier layer. Multilayer films can comprise a polyester layer in addition to a polyamide layer. For example, US 6,699,549 discloses multilayer structures comprising a polyester layer and a polyamide layer. However, the barrier properties, such as Oxygen Transmission Rate (OTR) values achieved by such kinds of a structure is generally greater than 0.2 cm³/m²/ 1 day/1 atm. It is, therefore, the object of the present disclosure to provide barrier films with enhanced barrier efficiency.

SUMMARY OF THE INVENTION

10 **[0006]** In an aspect of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of 1 μm – 25 μm.

15 **[0007]** In another aspect of the present disclosure, there is provided a process of preparing the multilayer barrier film comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of 1 μm – 25 μm, wherein
20 the film is prepared by a process selected from blown film process, cast film process, or lamination process of blown or cast films.

[0008] In yet another aspect of the present disclosure, there is provided a laminate comprising: (a) at least one print layer (**X**); (b) the multilayer barrier film (**F**) comprising: (i) at least one polyolefin core layer (**A**); (ii) at least one barrier layer (**B**)
25 on both the sides of the core layer; and (iii) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of 1 μm – 25 μm; and (c) at least one sealant layer (**Y**).

[0009] In a further aspect of the present disclosure, there is provided a process of preparing the laminate comprising: (a) at least one print layer (**X**); (b) the multilayer

barrier film (**F**) comprising: (i) at least one polyolefin core layer (**A**); (ii) at least one barrier layer (**B**) on both the sides of the core layer; and (iii) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of 1 μm – 25 μm ; and (c) at least one sealant layer (**Y**), the process comprising laminating the layer and the barrier film by adhesive lamination or extrusion lamination.

[0010] In another aspect of the present disclosure, there is provided an article comprising the multilayer barrier film of the present disclosure or the laminate of the present disclosure.

10 **[0011]** In yet another aspect of the present disclosure, there is provided a use of the multilayer barrier film of the present disclosure or the laminate of the present disclosure for packaging material.

[0012] These and other features, aspects and advantages of the present subject matter will be better understood with reference to the following description and appended claims. This summary is provided to introduce a selection of concepts in a simplified form. This summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

BRIEF DESCRIPTION OF DRAWINGS

20 **[0013]** The detailed description is described with reference to the accompanying figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The same numbers are used throughout the drawings to reference like features and components.

[0014] Figure 1 illustrates a cross-section of a multilayer barrier film (F; 100), according to an implementation of the present disclosure.

[0015] Figure 2 illustrates a cross-section of multilayer barrier film (F; 200) comprising tie layers, according to an implementation of the present disclosure.

[0016] Figure 3 illustrates a cross-section of a laminate (300) comprising multilayer barrier film (100), according to an implementation of the present disclosure.

[0017] Figure 4 illustrates a cross-section of laminate (400) comprising multilayer barrier film (200) having the tie layers, according to an implementation of the present disclosure.

DETAILED DESCRIPTION

5 **[0018]** Those skilled in the art will be aware that the present disclosure is subject to variations and modifications other than those specifically described. It is to be understood that the present disclosure includes all such variations and modifications. The disclosure also includes all such steps, features, compositions and compounds referred to or indicated in this specification, individually or collectively and any and
10 all combinations of any or more of such steps or features.

Definitions

[0019] For convenience, before further description of the present disclosure, certain terms employed in the specification, and examples are collected here. These definitions should be read in the light of the remainder of the disclosure and
15 understood as by a person of skill in the art. The terms used herein have the meanings recognized and known to those of skill in the art, however, for convenience and completeness, particular terms and their meanings are set forth below.

[0020] The articles “a”, “an” and “the” are used to refer to one or to more than one (i.e., to at least one) of the grammatical object of the article.

20 **[0021]** The terms “comprise” and “comprising” are used in the inclusive, open sense, meaning that additional elements may be included. Throughout this specification, unless the context requires otherwise the word “comprise”, and variations, such as “comprises” and “comprising”, will be understood to imply the inclusion of a stated element or step or group of element or steps but not the exclusion of any other element
25 or step or group of element or steps.

[0022] The term “including” is used to mean “including but not limited to”. “Including” and “including but not limited to” are used interchangeably.

[0023] The phrase “at least one polyolefin core layer (A)” refers to any polyethylene selected from the group consisting of high density polyethylene, medium density

polyethylene, low density polyethylene, linear low density polyethylene, polypropylene, propylene copolymers, ethylene copolymers, polymethyl pentene, and combinations thereof.

5 **[0024]** The phrase “at least one polyolefin layer (C)” refers to any polyethylene selected from the group consisting of high density polyethylene, medium density polyethylene, low density polyethylene, linear low density polyethylene, polypropylene, propylene copolymers, ethylene copolymers, polymethyl pentene and combinations thereof.

10 **[0025]** The phrase “high density polyethylene” as used herein refers to polyethylene having a density usually in the range of from about 0.94 g/cm³ to about 0.97 g/cm³. The term HDPE and high density polyethylene may be interchangeably used. The melt flow index may be in the range of 0.2 to 8 g/10min, more specifically in the range of 0.2 to 2.0 g/10 min.

15 **[0026]** The phrase “medium density polyethylene” as used herein refers to polyethylene having a density usually in the range of from about 0.926 g/cm³ to about 0.941 g/cm³. The term MDPE and medium density polyethylene may be interchangeably used.

20 **[0027]** The phrase “low density polyethylene” as used herein refers to polyethylene having a density usually in the range of from about 0.910 g/cm³ to about 0.925 g/cm³. The term LDPE and low density polyethylene may be interchangeably used.

[0028] The phrase “linear low density polyethylene” as used herein refers to polyethylene having a density usually in the range of from about 0.910 g/cm³ to about 0.930 g/cm³. The term LLDPE and linear low density polyethylene may be interchangeably used.

25 **[0029]** Ratios, concentrations, amounts, and other numerical data may be presented herein in a range format. It is to be understood that such range format is used merely for convenience and brevity and should be interpreted flexibly to include not only the numerical values explicitly recited as the limits of the range, but also to include all the individual numerical values or sub-ranges encompassed within that range as if each

numerical value and sub-range is explicitly recited. For example, a thickness range of about 20 μm to about 200 μm should be interpreted to include not only the explicitly recited limits of about 30 μm to about 180 μm , but also to include sub-ranges, such as 65 μm to 175 μm , 70 μm to 160 μm , and so forth, as well as individual amounts, including fractional amounts, within the specified ranges, such as 65.2 μm , 140.6 μm , and 161.3 μm , for example.

[0030] As discussed above, barrier film(s) with enhanced barrier properties is the need of the hour. Therefore, to address the need, the present disclosure provides multilayer barrier film which helps in increasing the barrier properties of the film using the same or lesser thickness of the at least one barrier layer. The structure of the multilayer barrier film is such that even with reduced thickness of the barrier layer, the barrier properties are surprisingly enhanced, i.e., replacing a single barrier layer of certain thickness with two barrier layers separated by a polyolefin core layer results in a film with enhanced barrier properties. Enhanced barrier properties herein refer to reduction of OTR approximately at least 2 - 15 times.

[0031] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of 1 μm – 25 μm . In an embodiment of the present disclosure, there is provided a multilayer barrier film as described herein, wherein the film with respect to the core layer can be symmetrical or asymmetrical in terms of layers.

[0032] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of 1 μm – 20 μm .

[0033] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer
5 individually has a thickness in the range of 2 μm – 20 μm .

[0034] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer
10 individually has a thickness in the range of 3 μm – 20 μm .

[0035] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer
15 individually has a thickness in the range of 5 μm – 18 μm .

[0036] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer
20 individually has a thickness in the range of 5 μm – 16 μm .

[0037] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer
25 individually has a thickness in the range of 5 μm – 15 μm .

[0038] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer

individually has a thickness in the range of 1 μm – 25 μm , further comprises at least one tie layer (**D**). In another embodiment of the present disclosure, the at least one tie layer (**D**) is present in between the at least one polyolefin core layer (**A**) and the at least one barrier layer (**B**). In yet another embodiment of the present disclosure, the at least one tie layer (**D**) is present in between the at least one barrier layer (**B**) and the at least one polyolefin layer (**C**). In a further embodiment of the present disclosure, the at least one tie layer is present between, the at least one polyolefin core layer (**A**) and the at least one barrier layer (**B**) and between the at least one barrier layer (**B**) and the at least one polyolefin layer (**C**). In yet another embodiment of the present disclosure, the at least one polyolefin core layer (**A**) and the at least one barrier layer (**B**) have to be connected via the at least one tie layer (**D**). The tie layer is therefore provided between the at least one barrier layer (**B**) and the at least one polyolefin core layer (**A**). The tie layer (**D**) ensures that the barrier layer (**B**) and polyolefin core layer (**A**) are sufficiently tightly connected to each other that both layers (**B**) and (**A**) can be jointly drawn and the mutual adhesion is preserved. In a further embodiment of the present disclosure, the at least one barrier layer (**B**) and the at least one polyolefin layer (**C**) have to be connected via the at least one tie layer (**D**). The tie layer is therefore provided between the at least one barrier layer (**B**) and the at least one polyolefin layer (**C**). The tie layer (**D**) ensures that the barrier layer (**B**) and polyolefin layer (**C**) are sufficiently tightly connected to each other that both layers (**B**) and (**C**) can be jointly drawn and the mutual adhesion is preserved. The at least one tie (**D**) layer is a layer based on modified polyolefins. The modified polyolefins are based on ethylene polymers or propylene polymers. The modified polyolefins may be selected from the group consisting of maleated polyethylene, ethylene-acrylic acid copolymer, ethylene-meth acrylic acid copolymer, anhydride grafted ethylene/1-butene copolymer, anhydride grafted ethylene/1-hexene copolymer, polypropylene, propylene ethylene copolymer, ethylene vinyl acetate copolymer, ethylene methyl acrylate copolymer, and anhydride grafted ethylene/1-octene copolymer.

[0039] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer
5 individually has a thickness in the range of 1 μm – 20 μm , and further comprises at least one tie layer (**D**). In another embodiment of the present disclosure, the at least one tie layer (**D**) is present in between the at least one polyolefin core layer (**A**) and the at least one barrier layer (**B**). In yet another embodiment of the present disclosure, the at least one tie layer (**D**) is present in between the at least one barrier layer (**B**) and the
10 at least one polyolefin layer (**C**). In a further embodiment of the present disclosure, the at least one tie layer (**D**) is present between, the at least one polyolefin core layer (**A**) and the at least one barrier layer (**B**) and between the at least one barrier layer (**B**) and the at least one polyolefin layer (**C**).

[0040] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) as described herein further comprises at least one tie layer (**D**), wherein
15 the at least one tie layer comprises a polymeric adhesive selected from the group consisting of maleated polyethylene, ethylene-acrylic acid copolymer, ethylene-meth acrylic acid copolymer, anhydride grafted ethylene/1-butene copolymer, anhydride grafted ethylene/1-hexene copolymer, polypropylene, propylene ethylene copolymer, ethylene vinyl acetate copolymer, ethylene methyl acrylate copolymer, and anhydride
20 grafted ethylene/1-octene copolymer.

[0041] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) as described herein further comprises at least one tie layer (**D**) and the at least one tie layer (**D**) has a thickness in the range of 2 μm - 40 μm . In another
25 embodiment of the present disclosure, the at least one tie layer (**D**) has a thickness in the range of 5 μm - 40 μm . In yet another embodiment of the present disclosure, the at least one tie layer (**D**) has a thickness in the range of 5 μm - 35 μm . In a further embodiment of the present disclosure, the at least one tie layer (**D**) has a thickness in

the range of 5 μm - 30 μm . In an alternate embodiment of the present disclosure, the at least one tie layer (**D**) has a thickness in the range of 10 μm - 30 μm .

[0042] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer (**B**) individually has a thickness in the range of 1 μm – 25 μm , and wherein the at least one polyolefin core layer is multilayer. In another embodiment of the present disclosure, the at least one polyolefin core layer (**C**) is a two-layered structure. In yet another embodiment of the present disclosure, the at least one polyolefin core layer (**C**) is a three-layered structure. In a further embodiment of the present disclosure, when the at least one polyolefin core layer (**C**) is a two-layered structure or three-layered structure, the two layers or three layers may be joined by a tie polyethylene layer.

[0043] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of 1 μm – 20 μm , and wherein the at least one polyolefin core layer is multilayer. In another embodiment of the present disclosure, the at least one polyolefin core layer (**C**) is a two-layered structure. In yet another embodiment of the present disclosure, the at least one polyolefin core layer (**C**) is a three-layered structure. In a further embodiment of the present disclosure, when the at least one polyolefin core layer (**C**) is a two-layered structure or three-layered structure, the two layers or three layers may be joined by a tie polyethylene layer.

[0044] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer

individually has a thickness in the range of $1\text{ }\mu\text{m} - 25\text{ }\mu\text{m}$, and wherein the at least one polyolefin core layer (**A**) comprises at least one polymer having a density in the range of $0.833\text{ g/cm}^3 - 0.99\text{ g/cm}^3$. In another embodiment of the present disclosure, the polymer has a density in the range of $0.855\text{ g/cm}^3 - 0.98\text{ g/cm}^3$. In yet another embodiment of the present disclosure, the polymer has a density in the range of $0.93\text{ g/cm}^3 - 0.96\text{ g/cm}^3$. In a further embodiment of the present disclosure, the polymer has a density in the range of $0.94\text{ g/cm}^3 - 0.96\text{ g/cm}^3$.

[0045] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of $1\text{ }\mu\text{m} - 20\text{ }\mu\text{m}$, and wherein the at least one polyolefin core layer (**A**) comprises at least one polymer having a density in the range of $0.833\text{ g/cm}^3 - 0.99\text{ g/cm}^3$. In another embodiment of the present disclosure, the polymer has a density in the range of $0.855\text{ g/cm}^3 - 0.98\text{ g/cm}^3$. In yet another embodiment of the present disclosure, the polymer has a density in the range of $0.93\text{ g/cm}^3 - 0.96\text{ g/cm}^3$. In a further embodiment of the present disclosure, the polymer has a density in the range of $0.94\text{ g/cm}^3 - 0.96\text{ g/cm}^3$.

[0046] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has thickness in the range of $1\text{ }\mu\text{m} - 25\text{ }\mu\text{m}$, and wherein the at least one polyolefin core layer (**A**) has a thickness in the range of $1\text{ }\mu\text{m} - 100\text{ }\mu\text{m}$. In an alternate embodiment of the present disclosure, the at least one polyolefin core layer (**A**) has a thickness in the range of $5\text{ }\mu\text{m} - 90\text{ }\mu\text{m}$. In another embodiment of the present disclosure, the at least one polyolefin core layer (**A**) has a thickness in the range of $20\text{ }\mu\text{m} - 90\text{ }\mu\text{m}$. In yet another embodiment of the present disclosure, the at least one polyolefin core layer (**A**) has a thickness in the range of $20\text{ }\mu\text{m} - 80\text{ }\mu\text{m}$. In a further

embodiment of the present disclosure, the at least one polyolefin core layer (**A**) has a thickness in the range of 20 μm – 60 μm .

[0047] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of 1 μm – 20 μm , and wherein the at least one polyolefin core layer (**A**) has a thickness in the range of 1 μm – 100 μm . In an alternate embodiment of the present disclosure, the at least one polyolefin core layer (**A**) has a thickness in the range of 5 μm – 90 μm . In another embodiment of the present disclosure, the at least one polyolefin core layer (**A**) has a thickness in the range of 20 μm – 90 μm . In yet another embodiment of the present disclosure, the at least one polyolefin core layer (**A**) has a thickness in the range of 20 μm – 80 μm . In a further embodiment of the present disclosure, the at least one polyolefin core layer (**A**) has a thickness in the range of 20 μm – 60 μm .

[0048] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of 1 μm – 25 μm , and wherein the at least one polyolefin layer (**C**) comprises at least one polymer having a density in the range of 0.833 g/cm^3 – 0.99 g/cm^3 . In another embodiment of the present disclosure, the polymer has a density in the range of 0.855 g/cm^3 – 0.98 g/cm^3 . In yet another embodiment of the present disclosure, the polymer has a density in the range of 0.93 g/cm^3 – 0.96 g/cm^3 . In a further embodiment of the present disclosure, the polymer has a density in the range of 0.94 g/cm^3 – 0.96 g/cm^3 .

[0049] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin

layer (C) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of $1\ \mu\text{m} - 20\ \mu\text{m}$, and wherein the at least one polyolefin layer (C) comprises at least one polymer having a density in the range of $0.833\ \text{g}/\text{cm}^3 - 0.99\ \text{g}/\text{cm}^3$. In another embodiment of the present disclosure, the polymer has a density in the range of $0.855\ \text{g}/\text{cm}^3 - 0.98\ \text{g}/\text{cm}^3$. In yet another embodiment of the present disclosure, the polymer has a density in the range of $0.93\ \text{g}/\text{cm}^3 - 0.96\ \text{g}/\text{cm}^3$. In a further embodiment of the present disclosure, the polymer has a density in the range of $0.94\ \text{g}/\text{cm}^3 - 0.96\ \text{g}/\text{cm}^3$.

[0050] In an embodiment of the present disclosure, there is provided a multilayer barrier film (F) comprising: (a) at least one polyolefin core layer (A); (b) at least one barrier layer (B) on both the sides of the core layer; and (c) at least one polyolefin (C) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of $1\ \mu\text{m} - 25\ \mu\text{m}$, and wherein the at least one polyolefin layer (C) has a thickness in the range of $3\ \mu\text{m} - 100\ \mu\text{m}$. In one another embodiment of the present disclosure, the at least one polyolefin layer (C) has a thickness in the range of $5\ \mu\text{m} - 90\ \mu\text{m}$. In an alternate embodiment of the present disclosure, the at least one polyolefin layer (C) has a thickness in the range of $15\ \mu\text{m} - 80\ \mu\text{m}$. In another embodiment of the present disclosure, the at least one polyolefin layer (C) has a thickness in the range of $15\ \mu\text{m} - 70\ \mu\text{m}$. In yet another embodiment of the present disclosure, the at least one polyolefin layer (C) has a thickness in the range of $18\ \mu\text{m} - 65\ \mu\text{m}$. In a further embodiment of the present disclosure, the at least one polyolefin layer (C) has a thickness in the range of $20\ \mu\text{m} - 60\ \mu\text{m}$.

[0051] In an embodiment of the present disclosure, there is provided a multilayer barrier film (F) comprising: (a) at least one polyolefin core layer (A); (b) at least one barrier layer (B) on both the sides of the core layer; and (c) at least one polyolefin (C) adjacent to the at least one barrier layer, wherein the at least one barrier layer (B) individually has a thickness in the range of $1\ \mu\text{m} - 20\ \mu\text{m}$, and wherein the at least one polyolefin layer (C) has a thickness in the range of $3\ \mu\text{m} - 100\ \mu\text{m}$. In one another embodiment of the present disclosure, the at least one polyolefin layer (C) has a

thickness in the range of 5 μm – 90 μm . In an alternate embodiment of the present disclosure, the at least one polyolefin layer (C) has a thickness in the range of 15 μm – 80 μm . In another embodiment of the present disclosure, the at least one polyolefin layer (C) has a thickness in the range of 15 μm – 70 μm . In yet another embodiment of the present disclosure, the at least one polyolefin layer (C) has a thickness in the range of 18 μm – 65 μm . In a further embodiment of the present disclosure, the at least one polyolefin layer (C) has a thickness in the range of 20 μm – 60 μm .

[0052] In an embodiment of the present disclosure, there is provided a multilayer barrier film (F) comprising: (a) at least one polyolefin core layer (A); (b) at least one barrier layer (B) on both the sides of the core layer; and (c) at least one polyolefin layer (C) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of 1 μm – 25 μm , and wherein the at least one polyolefin layer (C) is multilayer. In another embodiment of the present disclosure, the at least one polyolefin layer (C) is a two-layered structure. In yet another embodiment of the present disclosure, the at least one polyolefin layer (C) is a three-layered structure. In a further embodiment of the present disclosure, when the at least one polyolefin layer (C) is a two-layered structure or three-layered structure, the two layers or three layers may be joined by a tie polyethylene layer.

[0053] In an embodiment of the present disclosure, there is provided a multilayer barrier film (F) comprising: (a) at least one polyolefin core layer (A); (b) at least one barrier layer (B) on both the sides of the core layer; and (c) at least one polyolefin layer (C) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of 1 μm – 20 μm , and wherein the at least one polyolefin layer (C) is multilayer. In another embodiment of the present disclosure, the at least one polyolefin layer (C) is a two-layered structure. In yet another embodiment of the present disclosure, the at least one polyolefin layer (C) is a three-layered structure. In a further embodiment of the present disclosure, when the at least one polyolefin layer (C) is a two-layered structure or three-layered structure, the two layers or three layers may be joined by a tie polyethylene layer.

[0054] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of 1 μm – 25 μm , and wherein the at least one barrier layer comprises a member selected from the group consisting of ethylene vinyl alcohol, polyamide, polyethylene terephthalate or combinations thereof. Ethylene vinyl alcohol copolymer has an ethylene percentage ranging from 24-48 mol%

[0055] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of 1 μm – 25 μm , and wherein the at least one barrier layer comprises a member selected from the group consisting of ethylene vinyl alcohol, polyvinyl alcohol, polyamide, polyethylene terephthalate or combinations thereof. In case the barrier layer is ethylene vinyl alcohol, the ethylene vinyl alcohol copolymer has an ethylene percentage ranging from 24-48 mol %.

[0056] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has a thickness in the range of 1 μm – 20 μm , and wherein the at least one barrier layer comprises a member selected from the group consisting of ethylene vinyl alcohol, polyamide, polyethylene terephthalate or combinations thereof. Ethylene vinyl alcohol copolymer has an ethylene percentage ranging from 24-48 mol %.

[0057] In an embodiment of the present disclosure, there is provided a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer

individually has a thickness in the range of 1 μm – 20 μm , and wherein the at least one barrier layer comprises a member selected from the group consisting of ethylene vinyl alcohol, polyvinyl alcohol, polyamide, polyethylene terephthalate or combinations thereof.

- 5 **[0058]** In an embodiment of the present disclosure, there is provided a multilayer barrier film as described herein, wherein the film has a thickness in the range of 20 μm – 400 μm .

- [0059]** In an embodiment of the present disclosure, there is provided a multilayer barrier film as described herein, wherein the film has an OTR of equal to or less than
 10 0.2 $\text{cm}^3/\text{m}^2/1 \text{ day}/1 \text{ atm}$, at a temperature in the range of 22 $^{\circ}\text{C}$ - 25 $^{\circ}\text{C}$ at relative humidity in the range of 0 – 90 % RH. In another embodiment of the present disclosure, there is provided a multilayer barrier film as described herein, wherein the film has an OTR in the range of 0.005 - 0.2 $\text{cm}^3/\text{m}^2/1 \text{ day}/1 \text{ atm}$, at a temperature in the range of 22 $^{\circ}\text{C}$ - 25 $^{\circ}\text{C}$ at relative humidity in the range of 0 – 90 % RH. In yet
 15 another embodiment of the present disclosure, there is provided a multilayer barrier film as described herein, wherein the film has an OTR in the range of 0.005 - 0.05 $\text{cm}^3/\text{m}^2/1 \text{ day}/1 \text{ atm}$, at a temperature in the range of 22 $^{\circ}\text{C}$ - 25 $^{\circ}\text{C}$ at relative humidity in the range of 0 – 90 % RH. In a further embodiment of the present disclosure, there is provided a multilayer barrier film as described herein, wherein the film has an OTR
 20 in the range of 0.005 - 0.02 $\text{cm}^3/\text{m}^2/1 \text{ day}/1 \text{ atm}$, at a temperature in the range of 22 $^{\circ}\text{C}$ - 25 $^{\circ}\text{C}$ at relative humidity in the range of 0 – 90 % RH. In an alternate embodiment of the present disclosure, there is provided a multilayer barrier film as described herein, wherein the film has an OTR of (less than 0.05) < 0.05 $\text{cm}^3/\text{m}^2/1 \text{ day}/1 \text{ atm}$, at a temperature in the range of 22 $^{\circ}\text{C}$ - 25 $^{\circ}\text{C}$ at relative humidity in the
 25 range of 0 – 90 % RH.

[0060] In an embodiment of the present disclosure, there is provided a process of preparing the multilayer barrier film as described herein, wherein the film is prepared by a process selected from blown film process, cast film process, or lamination process of blown or cast films.

[0061] In an embodiment of the present disclosure, there is provided a process of preparing the multilayer barrier film as described herein, wherein the film is prepared by a blown film process in which the individual layers can be coextruded.

5 **[0062]** In an embodiment of the present disclosure, there is provided a process of preparing the multilayer barrier film as described herein, wherein the film is prepared by a cast film process.

[0063] In an embodiment of the present disclosure, there is provided a process of preparing the multilayer barrier film as described herein, wherein the film is prepared by lamination process of blown films.

10 **[0064]** In an embodiment of the present disclosure, there is provided a process of preparing the multilayer barrier film as described herein, wherein the film is prepared by lamination process of cast films.

[0065] In an embodiment of the present disclosure, there is provided a laminate comprising: (a) at least one print layer (**X**); (b) the multilayer barrier film (**F**) as described herein; and (c) at least one sealant layer (**Y**).

15 **[0066]** In an embodiment of the present disclosure, there is provided a laminate comprising: (a) at least one print layer (**X**); (b) the multilayer barrier film as described herein; and (c) at least one sealant layer (**Y**), wherein the at least one print layer comprises a polymer selected from high density polyethylene, medium density
20 polyethylene, low density polyethylene, linear low-density polyethylene, and combinations thereof.

[0067] In embodiment of the present disclosure, there is provided a laminate comprising: (a) at least one print layer (**X**); (b) the multilayer barrier film as described herein; and (c) at least one sealant layer (**Y**), wherein the at least one print layer is a
25 single layer or multilayer structure. In another embodiment of the present disclosure, the at least one print layer (**X**) is a two-layered structure. In yet another embodiment of the present disclosure, the at least one print layer (**X**) is a three-layered structure. In a further embodiment of the present disclosure, when the at least one print layer (**X**) is a

two-layered structure or three-layered structure, the two layers or three layers may be joined by a tie polyethylene layer.

[0068] In an embodiment of the present disclosure, there is provided a laminate comprising: (a) at least one print layer (**X**); (b) the multilayer barrier film as described
5 herein; and (c) at least one sealant layer (**Y**), wherein the at least one sealant layer (**Y**) comprises a polymer selected from high density polyethylene, medium density polyethylene, low density polyethylene, linear low-density polyethylene, linear low density polyethylene, and combinations thereof.

[0069] In an embodiment of the present disclosure, there is provided a laminate
10 comprising: (a) at least one print layer (**X**); (b) the multilayer barrier film as described herein; and (c) at least one sealant layer (**Y**), wherein the at least one sealant layer (**Y**) is a single layer or multilayer structure. In another embodiment of the present disclosure, the at least one sealant layer (**Y**) is a two-layered structure. In yet another embodiment of the present disclosure, the at least one sealant layer (**Y**) is a three-
15 layered structure. In a further embodiment of the present disclosure, when the at least one sealant layer (**Y**) is a two-layered structure or three-layered structure, the two layers or three layers may be joined by a tie polyethylene layer.

[0070] In an embodiment of the present disclosure, there is provided a laminate comprising: (a) at least one print layer (**X**); (b) the multilayer barrier film as described
20 herein; and (c) at least one sealant layer (**Y**), wherein the at least one print layer has a thickness in the range of 50 μm – 200 μm .

[0071] In an embodiment of the present disclosure, there is provided a laminate comprising: (a) at least one print layer (**X**); (b) the multilayer barrier film as described herein; and (c) at least one sealant layer (**Y**), wherein the at least one sealant layer has
25 a thickness in the range of 50 μm – 200 μm .

[0072] In an embodiment of the present disclosure, there is provided a laminate comprising: (a) at least one print layer (**X**); (b) the multilayer barrier film (**F**) as described herein; and (c) at least one sealant layer (**Y**), wherein the laminate reduces

the OTR by at least 2 times in comparison to single barrier layer of about similar thickness.

5 **[0073]** In an embodiment of the present disclosure, there is provided a laminate comprising: (a) at least one print layer (**X**); (b) the multilayer barrier film (F) as described herein; and (c) at least one sealant layer (**Y**), wherein the laminate reduces the OTR by at least 5 times in comparison to single barrier layer of about similar thickness.

10 **[0074]** In an embodiment of the present disclosure, there is provided a laminate comprising: (a) at least one print layer (**X**); (b) the multilayer barrier film (F) as described herein; and (c) at least one sealant layer (**Y**), wherein the laminate reduces the OTR by at least 7 times in comparison to single barrier layer of about similar thickness.

15 **[0075]** In an embodiment of the present disclosure, there is provided a laminate comprising: (a) at least one print layer (**X**); (b) the multilayer barrier film (F) as described herein; and (c) at least one sealant layer (**Y**), wherein the laminate reduces the OTR by at least 10 times in comparison to single barrier layer of about similar thickness.

20 **[0076]** In an embodiment of the present disclosure, there is provided a laminate comprising: (a) at least one print layer (**X**); (b) the multilayer barrier film (F) as described herein; and (c) at least one sealant layer (**Y**), wherein the laminate reduces the OTR by at least 5 -10 times in comparison to single barrier layer of about similar thickness.

25 **[0077]** In an embodiment of the present disclosure, there is provided a laminate as described herein, wherein the laminate has an OTR of equal to or less than $0.2 \text{ cm}^3/\text{m}^2/1 \text{ day}/1 \text{ atm}$, at a temperature in the range of $22^\circ\text{C} - 25^\circ\text{C}$ at relative humidity in the range of $0 - 90\% \text{ RH}$. In another embodiment of the present disclosure, there is provided a laminate as described herein, wherein the laminate has an OTR in the range of $0.005 - 0.2 \text{ cm}^3/\text{m}^2/1 \text{ day}/1 \text{ atm}$, at a temperature in the range of $22^\circ\text{C} - 25^\circ\text{C}$ at relative humidity in the range of $0 - 90\% \text{ RH}$. In yet another embodiment of the

present disclosure, there is provided a laminate as described herein, wherein the laminate has an OTR in the range of $0.005 - 0.05 \text{ cm}^3/\text{m}^2/1 \text{ day}/1 \text{ atm}$, at a temperature in the range of $22^\circ\text{C} - 25^\circ\text{C}$ at relative humidity in the range of $0 - 90\%$ RH. In a further embodiment of the present disclosure, there is provided a laminate as described herein, wherein the laminate has an OTR in the range of $0.005 - 0.02 \text{ cm}^3/\text{m}^2/1 \text{ day}/1 \text{ atm}$, at a temperature in the range of $22^\circ\text{C} - 25^\circ\text{C}$ at relative humidity in the range of $0 - 90\%$ RH. In an alternate embodiment of the present disclosure, there is provided a laminate as described herein, wherein the laminate has an OTR of $(\text{less than } 0.05) < 0.05 \text{ cm}^3/\text{m}^2/1 \text{ day}/1 \text{ atm}$, at a temperature in the range of $22^\circ\text{C} - 25^\circ\text{C}$ at relative humidity in the range of $0 - 90\%$ RH.

[0078] In an embodiment of the present disclosure, there is provided a process of preparing the laminate as described herein, the process comprising laminating the layer by extrusion lamination or adhesion lamination.

[0079] In an embodiment of the present disclosure, there is provided a process of preparing the laminate as described herein, the process comprising laminating the layer by adhesive lamination.

[0080] In an embodiment of the present disclosure, there is provided a process of preparing the laminate as described herein, the process comprising laminating the layer by extrusion lamination.

[0081] In an example, the multilayer film is as represented in Figure 1. The cross-section of the multilayer film 100 from comprises a polyolefin core layer (**A**); a barrier layer (**B**) on both the sides of the core layer (A) and a polyolefin layer (**C**) adjacent to both the barrier layer. The barrier layer (B) individually may have a thickness of $6 \mu\text{m}$ each. In an example, the barrier layer may be of a thickness of $6 \mu\text{m}$ and $3 \mu\text{m}$ individually. In another example, the barrier layer may be of a thickness of $3 \mu\text{m}$ and $10 \mu\text{m}$ individually. The barrier layer may be selected from EVAL™, SoarnoL™, or Evasin®. The polyolefin core layer (A) comprises a polymer having density in the range of $0.833 \text{ g}/\text{cm}^3 - 0.99 \text{ g}/\text{cm}^3$. The polyolefin core layer may comprise polymer selected from high density polyethylene, medium density polyethylene, low density

polyethylene, linear low-density polyethylene, or combinations thereof. The polyolefin core layer may have a thickness in the range of 1 μm – 100 μm . In an example the polyolefin core layer may be of thickness 90 μm . In another example the polyolefin core layer may be of thickness 80 μm . In yet another example, the polyolefin core layer may have a thickness of 60 μm . In a further example, the polyolefin core layer may have a thickness of 62 μm .

[0082] As shown in Figure 1 the polyolefin layer (C) is present adjacent to the barrier layer (B). The polyolefin layer may be single layer or a multilayer structure. In an example, the polyolefin layer may be a two layer structure. In another example, the polyolefin layer may be a three layer structure. The polyolefin layer comprises a polymer having a density in the range of 0.920 g/cm^3 – 0.990 g/cm^3 . The polymer in the polyolefin layer may be selected from high density polyethylene, medium density polyethylene, low density polyethylene, linear low-density polyethylene, or combinations thereof. The polyolefin layer may have a thickness in the range of 3 μm – 100 μm . In an example the polyolefin layer may be of thickness 30 μm . In another example the polyolefin layer may be of thickness 32 μm . In yet another example, the polyolefin layer may have a thickness of 15 μm . In a further example, the polyolefin layer may have a thickness of 85 μm .

[0083] Figure 2 differs from Figure 1 only in that the multilayer barrier film further comprises at least the tie layer (D). In an example, the multilayer barrier film comprising at least one tie layer (200) is represented in Figure 2. The multilayer barrier film as shown in Figure 2 further comprises at least one tie layer (D) to form the multilayer barrier film. In an example, one or more tie layer(s) may be disposed between the at least one polyolefin core layer and at least one barrier layer. In another example, the tie layer may be present between the at least one barrier layer and the at least one polyolefin layer. In yet another example, the tie layer is chosen to maximize compatibility within the layer(s) and to maximize adhesion between the layer(s). In a further example, if the barrier layer is EVOH layer a tie layer comprising a maleated polyethylene or maleic anhydride grafted polymer may be present between the at least

one barrier layer and the at least one polyolefin layer. In an alternate example, if the barrier layer is EVOH layer a tie layer comprising a maleated polyethylene or maleic anhydride grafted polymer may be present between the at least one barrier layer and the at least one polyolefin core layer. The tie layer may have a thickness in the range of 2 μm - 40 μm . In an example, the tie layer may have a thickness of 5 μm . In another example the tie layer may have a thickness of 8 μm .

[0084] Figure 3 illustrates the laminate (300) of the present disclosure, wherein the multilayer barrier film of the Figure 1 is used to prepare the laminate. As can be seen from Figure 3 the laminate comprises at least one print layer (**X**), and at least one sealant layer (**Y**). In an example, the at least one print layer may be a single layer or multiple layer. In an example the print layer is a two-layer structure or a three-layer structure. The print layer comprises polymer selected from high density polyethylene, medium density polyethylene, low density polyethylene, linear low-density polyethylene, and combinations thereof. In an example, the print layer may have a thickness in the range of 50 μm – 200 μm . In another example, the print layer has a thickness of 80 μm .

[0085] In an example the at least one sealant layer (**Y**) may be absent. In another example, the at least one sealant layer may be present and may be a single layer or multiple layer. In an example the sealant layer is a two-layer structure or a three-layer structure. The sealant layer comprises polymer selected from high density polyethylene, medium density polyethylene, low density polyethylene, linear low-density polyethylene, and combinations thereof. In an example, the sealant layer may have a thickness in the range of 50 μm – 200 μm . In another example, the sealant layer has a thickness of 50 μm .

[0086] In an example, the laminate may comprise at least one print layer and at least one barrier film. In such a laminate the sealant layer is absent. In another example, the laminate may comprise at least one print layer (**X**)/at least one barrier film (**F**)/at least one sealant layer (**Y**).

[0087] Figure 4 depicts the laminate (400) of the present disclosure, wherein the laminate of Figure 3 further comprises at least one tie layer (D) to form the laminate 400. In an example, one or more tie layer(s) may be disposed between the at least one polyolefin core layer and at least one barrier layer. In another example, the tie layer
5 may be present between the at least one barrier layer and the at least one polyolefin layer. In yet another example, the tie layer is chosen to maximize compatibility within the layer(s) and to maximize adhesion between the layer(s). In a further example, if the barrier layer is EVOH layer a tie layer comprising a maleated polyethylene or maleic anhydride grafted polymer may be present between the at least one barrier layer and
10 the at least one polyolefin layer. In an alternate example, if the barrier layer is EVOH layer a tie layer comprising a maleated polyethylene or maleic anhydride grafted polymer may be present between the at least one barrier layer and the at least one polyolefin core layer. The tie layer may have a thickness in the range of 2 μm - 40 μm . In an example, the tie layer may have a thickness of 5 μm . In another example the tie
15 layer may have a thickness of 8 μm .

[0088] As can be seen from Figure 4 the laminate comprises at least one print layer (X), and at least one sealant layer (Y). In an example, the at least one print layer may be a single layer or multiple layer. The print layer comprises polymer selected from high density polyethylene, medium density polyethylene, low density polyethylene,
20 linear low-density polyethylene, and combinations thereof. In an example, the print layer may have a thickness in the range of 50 μm – 200 μm . In another example, the print layer has a thickness of 80 μm .

[0089] In an example, the at least one sealant layer may be a single layer or multiple layer. The sealant layer comprises a polymer selected from high density polyethylene, medium density polyethylene, low density polyethylene, linear low-density
25 polyethylene, and combinations thereof. In an example, the sealant layer may have a thickness in the range of 50 μm – 200 μm . In another example, the sealant layer has a thickness of 50 μm .

[0090] In an embodiment of the present disclosure, there is provided an article comprising the multilayer barrier film of the present disclosure.

[0091] In an embodiment of the present disclosure, there is provided an article comprising the laminate of the present disclosure.

5 **[0092]** In an embodiment of the present disclosure, there is provided a use of the multilayer barrier film of the present disclosure for a packaging material. The multilayer barrier film may be used in making the inner barrier liners (IBL), shoulder barrier liners (SBL), lami-tube, or a packaging material. The barrier film of the present disclosure may be used as an inner barrier liner (IBL) in a packaging material or the
10 shoulder barrier liner (SBL) of packaging material or the sleeve of a packaging material or Top seal of a packaging material. The IBL/SBL/Top seal works as an effective moisture and oxygen barrier for packaging products which are environmentally sensitive. The packaging material may be a lami-tube.

[0093] In an embodiment of the present disclosure, there is provided a use of the
15 laminate of the present disclosure for a packaging material. In another embodiment of the present disclosure, the packaging material may be lami-tube.

[0094] Although the subject matter has been described in considerable detail with reference to certain examples and implementations thereof, other implementations are possible.

20 **Examples**

[0095] The disclosure will now be illustrated with working examples, which is intended to illustrate the working of disclosure and not intended to take restrictively to imply any limitations on the scope of the present disclosure. Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly
25 understood to one of ordinary skill in the art to which this disclosure belongs. Although methods and materials similar or equivalent to those described herein can be used in the practice of the disclosed methods and compositions, the exemplary methods, devices and materials are described herein. It is to be understood that this

disclosure is not limited to particular methods, and experimental conditions described, as such methods and conditions may apply.

Abbreviations:

MA-grafted tie layer: maleic anhydride grafted tie layer

- 5 EVOH: ethylene vinyl alcohol, wherein the ethylene content is 24-48 mol%.

EXAMPLE 1

Process for preparing a multilayer barrier film and a laminate of the present disclosure.

- [0096] The multilayer barrier film of the present disclosure is prepared by blown film
 10 extrusion, wherein all the layers are prepared by blown film extrusion and then are
 extrusion laminated to form the multilayer barrier film. The process of film extrusion
 is a well-known process as discussed in the references [H.F. Guiles Jr., J.R. Wagner
 Jr., E.M. Mount III, Extrusion The definitive processing guide and handbook, William
 Andrew Inc, Norwich, NY, (2005), 453–463; and T.I. Butler, G.E. Ealer, S.B. Marks,
 15 G.D. Oliver, J. Perdikoulis. (eds) Film extrusion manual, 2nd edn. TAPPI (2005)].

- [0097] The multilayer barrier film of the present disclosure can also be made by a cast
 film process well known in the art. More detailed information regarding the cast film
 process can be extracted from the following references: H.F. Guiles Jr., J.R. Wagner
 Jr., E.M. Mount, III, Extrusion The definitive processing guide and handbook,
 20 William Andrew Inc, Norwich, NY, (2005), 301–306; T.I. Butler, G.E. Ealer, S.B.
 Marks, G.D. Oliver, J. Perdikoulis. (eds) Film extrusion manual, 2nd edn. TAPPI
 (2005); J. Vlachopoulos, J.R. Wagner, Jr., The SPE guide on extrusion technology
 and troubleshooting, Society of Plastics Engineers, Brookfield, CT, (2001); and A.R.
 Calhoun, J.R. Wagner, Jr., Extrusion processes, Plastics technician's toolbox, book 6,
 25 Society of Plastics Engineers, Brookfield, CT, (2004).

[0098] For the preparation of Film 1, firstly, a 5-layered barrier film (25µm
 (polyolefin layer; 80%HDPE+20%LDPE) / 5 µm maleated-PE (tie layer)/ 6µm EVOH
 (barrier layer)/ 5 µm maleated-PE (tie layer)/ 30 µm PE (polyolefin core layer) was
 produced by using a co-extruded blown film and was taken from the first unwinding

station to the extrusion station. Secondly, an another Film 1 of 5-layer film (30 μm (polyolefin core layer; 58 % HDPE + 42 % LDPE) / 5 μm maleated-PE (tie layer)/ 6 μm EVOH (barrier layer)/ 5 μm maleated-PE (tie layer) / 25 μm (polyolefin layer; 80 % HDPE + 20 %LDPE)) was produced by using a co-extruded blown film and was taken from the second unwinding station to the extrusion lamination station to bond together utilizing a 20 μm PE (LDPE/LLDPE melt) to make a multilayer barrier film having staggered barrier layer of 6 μm and 6 μm separated by a 80 μm polyolefin core layer. The manufacturing process in this invention uses general available machines such as a co-extruded blown film manufacturing line, a co-extrusion lamination line.

[0099] Using the process as described above, Film 2, Film 3, Film 4, Film 5 were prepared, wherein the structure/layering of the films are as described in the Table 3.

[00100] Various kinds of multilayer barrier films are possible and may be prepared as per the process described above. In an example the multilayer barrier film of present disclosure may have structure as explained below. The structures may be created with various polyolefin layer blends. The polyolefin layer may be a single layer in some examples and may be a multilayer structure in another example. In case of a multilayer structure the polyolefin layer may comprise barrier layer also. The barrier layer may be selected from EVOH or polyamide as per requirement. The PE of the polyolefin layer may be a blend of polyethylenes selected from high density polyethylene, medium density polyethylene, low density polyethylene, linear low-density polyethylene, and combinations thereof.

[00101] Table 1: Multilayer barrier film

S.No .	Polyolefin layer	Barrier layer	Polyolefin core layer	Barrier layer	Polyolefin layer
1	PE	EVOH	PE	EVOH	PE
2	PE	EVOH	PE	EVOH	PE//EVOH//PE

3.	PE	polyamide	PE	polyamide	PE
4.	PE	polyamide	PE	EVOH	PE
5.	PE	EVOH	PE	polyamide	PE
6.	PE	polyamide	PE	Polyamide	PE//polyamide//PE
7.	PE	polyamide	PE	EVOH	PE//polyamide//PE
8.	PE//EVOH //PE	polyamide	PE	polyamide	PE
9.	PE	polyamide	PE	Polyamide	PE//EVOH//PE
10.	PE/PE	EVOH	PE	EVOH	PE//EVOH//PE/PE
11.	PE/PE	EVOH	PE	EVOH	PE/PE
12.	PE/PE	polyamide	PE	polyamide	PE/PE
13.	PE/PE	polyamide	PE	EVOH	PE/PE
14.	PE/PE	EVOH	PE	polyamide	PE/PE
15.	PE/PE	polyamide	PE	Polyamide	PE//polyamide//PE/ PE
16.	PE/PE	polyamide	PE	EVOH	PE//polyamide//PE/ PE
17.	PE/PE	EVOH	PE	polyamide	PE//polyamide//PE/ PE
18.	PE/PE	polyamide	PE	Polyamide	PE//EVOH//PE/PE
19.	PE/PE/PE	EVOH	PE	EVOH	PE//EVOH//PE/PE/

					PE
20.	PE/PE/PE	EVOH	PE	EVOH	PE/PE/PE
21.	PE/PE/PE	polyamide	PE	polyamide	PE/PE/PE
22.	PE/PE/PE	polyamide	PE	EVOH	PE/PE/PE
23.	PE/PE/PE	EVOH	PE	polyamide	PE/PE/PE
24.	PE/PE/PE	polyamide	PE	Polyamide	PE//polyamide//PE/ PE/PE
25.	PE/PE/PE	polyamide	PE	EVOH	PE//polyamide//PE/ PE/PE
26.	PE/PE/PE	EVOH	PE	polyamide	PE//polyamide//PE/ PE/PE
27.	PE/PE/PE	polyamide	PE	Polyamide	PE//EVOH//PE/PE/ PE
28.	PE	EVOH	PE	Polyamide	PE//EVOH//PE

[00102] In all the examples provided above the at least one barrier layer may be replaced by a polyester layer. Moreover, the polyolefin layer, barrier layer, and polyolefin core layer are connected via at least one tie layer D. The tie layer is provided between the various layers to ensure that the layers are sufficiently tightly connected to each other and that the connected layers can be jointly drawn and the mutual adhesion may be preserved. The adhesive layer is a layer based on modified polyolefins. The tie layer is a 5 μm maleated-PE.

Process of preparing a laminate:

[00103] The multilayer barrier film made by blown film process or the cast film process as described above may be used to prepare a laminate, wherein the laminate includes at least one print layer (X), and optionally at least one sealant layer (Y). The process of preparing a laminate may be selected from either an adhesive lamination process or extrusion lamination process.

[00104] More details regarding the lamination process are present in Wolf R. "A technology decision-adhesive lamination or extrusion coating/lamination?" In: Tappi place Conference, April Albuquerque (NM); 2010. Viewed on 26th May 2020, from: <https://imisrise.tappi.org/TAPPI/Products/10/PLA/10PLA57.aspx> which is hereby incorporated by reference.

[00105] The process of preparation of the laminate of the present disclosure is the same as the process of preparation of film.

[00106] For the preparation of Laminate 1, firstly, a 5-layered barrier film ([25 µm (sealant layer; 80 % LLDPE + 20 % LDPE) / 5 µm maleated-PE (tie layer)/ 3µmEVOH(barrier layer) / 5 µm maleated-PE (at least one tie layer)/ 10µm PE (polyolefin core layer)] was produced by using a co-extruded blown film and was taken from the first unwinding station to the extrusion station. Secondly, an another Laminate 1 of 5-layer barrier film [35µm PE (polyolefin core layer) / 10 µm maleated-PE (tie layer)/ 10µmEVOH (barrier layer)/ 10 µm maleated-PE (tie layer)//35 µm (print layer: [15 µmPE (polyolefin layer) was produced by using a co-extruded blown film and was taken from the second unwinding station to the first extrusion lamination station to bond together utilizing a 20 µm PE (LDPE/LLDPE melt), this laminate was further laminated to 50 µm [80% LLDPE + 20 % LDPE] sealant utilizing 20 µm tie layer in second extrusion lamination to make final laminate of the present disclosure comprising the print layer (X) and the sealant layer (Y). The laminate can be made by utilizing single extrusion lamination or tandem extrusion lamination depending upon the final architecture.

[00107] For Laminate 2, the structure shown in the Table 4 was extrusion laminated using a similar process as per the structure of Laminate 1.

EXAMPLE 2**Barrier properties of the multilayer barrier film of the present disclosure**

[00108] A series of tests were conducted on the various films prepared by the process as explained in Example 1. The test condition used for conduction the OTR test are in Table 2 below:

[00109] Table 2

Test Condition	For OTR testing
Standard Used	ASTM D 3985-05
Room Temp.	22 +/- 2 °C
Test Temp.	23 +/- 0.5 °C
Test RH	0% +/- 3% RH
Carrier RH	0% +/- 3% RH
Conditioning	1 Hr
Test Area	50 cm ²
Machine Model	MOCON OTR 2/22-L

[00110] The OTR results of various multilayer barrier films are recorded in Table 3. The purpose of these tests was to demonstrate that the OTR varies if a single barrier layer is used in the film in comparison to a film wherein the two barrier layers are used separated by a polyolefin core layer. The structure and design of the multilayer barrier film of the present disclosure provided enhanced barrier properties and the same was confirmed by the extremely low oxygen transmission rate (OTR) values.

[00111] Table 3 illustrates that when a single barrier layer was used in the multilayer barrier film an OTR value of 0.32 was attained (CF1). In contrast, if the single barrier layer was replaced by two barrier layers separated by a polyolefin core layer, such a multilayer barrier film (Film 1, Film 2, and Film 3) showed extremely low oxygen transmission rate (OTR) values, i.e., < 0.05. It can thus be inferred that the presence of the polyolefin core layer (Film 1, Film 2, Film 3) and having two barrier (EVOH) layers of similar thickness, resulted in the enhancement of barrier properties, i.e., unexpected low OTR values.

[00112] Similar inference can be drawn from the Film 4 and the comparative films CF2, CF3, and CF4. CF2, CF3, and CF4 individually had barrier layers of 15 μm , but when the single layer was replaced by two barrier layers separated by a polyolefin core layer, i.e., Film 4 a drastic reduction in the oxygen transmission rate was observed, thereby improving the barrier properties.

[00113] Analogous results were observed with Film 5 and Comparative Film 5. Comparative Film 5 showed an oxygen transmission rate value of 19, but when two barrier layers of 48 μm each were separated by polyolefin core layer substantial reduction in the oxygen transmission rate was observed, i.e, an OTR value of 2 was achieved at 0 % RH.

[00114] From the above explanation splitting the barrier layer into two layers creates structural and physical improvements in terms of barrier properties in the film and the laminate. For example, if a comparison is drawn between an individual EVOH layer and a EVOH layer that is split into two layers side by side separated by a polyethylene layer, the film/laminate produced have improved barrier properties.

[00115] Table 3: Multilayer barrier films with OTR values

S.No	Films	Barrier layer Variant	Structure	barrier layer thickness	OTR cc/m ² .day; @ 0% RH
1.	Film 1	EVAL™	25 μm (polyolefin layer; 80%HDPE+20%LDPE) / 5 μm maleated-PE (tie layer)/ 6 μm EVOH (barrier layer)/ 5 μm maleated-PE (tie layer) / 80 μm PE (polyolefin core layer) / 5 μm maleated-PE (tie layer)/ 6 μm EVOH (barrier layer)/ 5 μm	6 μm + 6 μm	< 0.05

			maleated-PE (tie layer) / 25µm (polyolefin layer; 80 % HDPE + 20 %LDPE)		
2.	Film 2	EVAL™	25µm (polyolefin layer; 80%HDPE+20%LDPE) / 5 µm maleated-PE (tie layer)/ 6µm EVOH (barrier layer)/ 5 µm maleated-PE (tie layer)/ 60 µm PE (polyolefin core layer) / 5 µm maleated-PE (tie layer) / 6µm EVOH (barrier layer)/ 5 µm maleated-PE (tie layer)/ 25µm (polyolefin layer; 80 % HDPE + 20 %LDPE)	6 µm +6 µm	< 0.05
3.	CF1	EVAL™	90µmPE // 12 µm EVOH // 50µmPE	12 µm	0.32
4.	Film 3	EVAL™	25µm (polyolefin layer; 80%HDPE+20%LDPE) / 5 µm maleated-PE (tie layer)/ 6µm EVOH (barrier layer)/ 5 µm maleated-PE (tie layer)/ 55 µm PE (polyolefin core layer) / 5 µm maleated-PE (tie layer)/ 3µmEVOH (barrier layer)/ 5 µm maleated-PE (tie layer)/ 10µm PE (polyolefin layer)	6µm + 3 µm	< 0.05

5.	Film 4	EVAL™; Nylon-6	25 μm (80%HDPE+20%LDPE) / 5 μm maleated-PE / 5μmEVOH / 5μm polyamide / 5μmEVOH / 5 μm maleated- PE / 50μm (polyolefin core layer; 80%HDPE+20%LDPE) / 5 μm maleated-PE / 5μmEVOH / 5μm polyamide / 5μmEVOH / 5 μm maleated- PE / 25μm(80%HDPE+20%LDPE)	15 μm+ 15 μm	0.02
8.	CF2	EVAL™; Nylon-6	25 μm (80%HDPE+20%LDPE) / 5 μm maleated-PE / 5μmEVOH / 5μm polyamide / 5μmEVOH / 5 μm maleated- PE / 25μm(80%HDPE+20%LDPE)	15μm	0.22
7.	CF3	EVAL™	25 μm (80%HDPE+20%LDPE) / 5 μm maleated-PE // 15μmEVOH // 5 μm maleated-PE / 25μm(80%HDPE+20%LDPE	15 μm	0.22

			)		
6.	CF4	EVAL™	20 μm (80%HDPE+20%LDPE) / 5 μm maleated-PE // 11 μm EVOH // 5 μm maleated-PE / 10 μm (80%HDPE+20%LDPE)	11 μm	0.32
5.	Film 5	Nylon-6	80 μm PE (polyolefin layer; HDPE)/ 16 μm modified PE (tie layer; maleated LLDPE)/24 μm polyamide (barrier layer) /16 μm modified PE(tie layer; maleated LLDPE) /24 μm polyamide (barrier layer)// 80 μm PE (polyolefin core layer; HDPE) / 16 μm modified PE (tie layer; maleated LLDPE)/24 μm polyamide (barrier layer)/16 μm modified PE(tie layer; maleated LLDPE)/ 24 μm polyamide (barrier layer)	(24 μm + 24 μm) + (24 μm + 24 μm)	2
9.	CF5	Nylon-6	24 μm polyamide/ 16 μm modified PE/24 μm polyamide/16 μm modified PE (maleated LLDPE) / 80 μm PE	24 μm + 24 μm	19

EXAMPLE 3**Barrier properties of the laminate of the present disclosure**

[00116] Barrier effectiveness of the laminate of the present disclosure was also specifically OTR at 0% RH, in a similar manner as described for the multilayer barrier film explained in Example 2. The test conditions were similar to the ones provided in Table 2.

[00117] Table 4: Laminate of the present disclosure comprising print layer and optionally a sealant layer

S.No	Laminate	Barrier	Structure	Barrier layer thickness	OTR cc/m ² .day; @ 0% RH
1.	Laminate 1	EVAL™	[25 µm (sealant layer; 80 % LLDPE + 20 % LDPE) / 5 µm maleated-PE (tie layer)/ 3µmEVOH(barrier layer) / 5 µm maleated-PE (at least one tie layer)/ 10µm PE (polyolefin core layer)] // 20 µmPE (polyolefin core layer)// [35µm PE (polyolefin core layer) / 10 µm maleated-PE (tie layer)/ 10µmEVOH (barrier layer)/ 10 µm maleated-PE (tie layer)//15 µmPE (polyolefin layer)] // 20 µm PE (polyolefin layer or tie layer)// 50 µm (; 80 % LLDPE + 20 %LDPE)	3µm +10µm	< 0.05
2.	Laminate 2	EVAL™; Nylon-6	25 µm (print layer; 80%HDPE+20%LDPE) / 5 µm maleated-PE (tie layer)/ 5µmEVOH	15µm+15µm	0.02

			(barrier layer)/ 5µm polyamide (barrier layer)/ 5µmEVOH (barrier layer)/ 5 µm maleated-PE (tie layer)/ 25µm(polyolefin core layer; 80%HDPE+20%LDPE) // 25 µm (polyolefin core layer; 80%HDPE+20%LDPE) / 5 µm maleated-PE (tie layer)/ 5µmEVOH (barrier layer)/ 5µm polyamide (barrier layer)/ 5µmEVOH (barrier layer)/ 5 µm maleated-PE (tie layer)/ 25µm(polyolefin layer; 80%HDPE+20%LDPE)		
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[00118] From the above Table 4 it is discernible, that replacing a single barrier layer of certain thickness with two barrier layers separated by a polyolefin core layer results in a laminate with enhanced barrier properties, i. e, an OTR of 0.02 -0.05 cc/m².day at 0% RH. Reduction of approximately at least 2 - 15 times was observed in the OTR. The polyolefin core layer may be a single layer or multiple layers having thickness in the range of 1 µm - 100 µm. The constituents of the polyolefin core layer may be selected from the group consisting of high density polyethylene, low density polyethylene, linear low density polyethylene, polypropylene, polypropylene copolymers, and combinations thereof.

Advantages of the present disclosure:

[00119] The multilayer barrier film and the laminate of the present disclosure provides enhanced barrier properties. The structure of the film and the laminate is such that an OTR in the range of 0.005 – 0.2 cm³/m²/ 1 day/1 atm, at a temperature in the range of 22 °C- 25 °C, at relative humidity in the range of 0 to 90% RH is achieved.

[00120] The design of the multilayer barrier film enhances economic value compared to commercial films and help in achieving multilayer film design with lesser film thickness yet higher barrier properties.

[00121] Although the subject matter has been described in considerable detail
5 with reference to certain examples and implementations thereof, other implementations are possible. As such, the spirit and scope of the appended claims should not be limited to the description of the preferred examples and implementations contained therein.

I/We Claim:

- 1) A multilayer barrier film (**F**) comprising:
 - (a) at least one polyolefin core layer (**A**);
 - (b) at least one barrier layer (**B**) on both the sides of the core layer; and
 - 5 (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has thickness in the range of $1\ \mu\text{m} - 25\ \mu\text{m}$.
- 2) The multilayer barrier film as claimed in claim 1, wherein the at least one barrier layer individually has thickness in the range of $1\ \mu\text{m} - 20\ \mu\text{m}$
- 10 3) The multilayer barrier film as claimed in claim 1, further comprises at least one tie layer (**D**).
- 4) The multilayer barrier film as claimed in claim 3, wherein the at least one tie layer comprises polymeric adhesive selected from the group consisting of maleated polyethylene, anhydride grafted ethylene/1-butene copolymer, anhydride grafted ethylene/1-hexene copolymer, polypropylene, propylene ethylene copolymer, ethylene vinyl acetate copolymer, ethylene methyl acrylate copolymer, and anhydride grafted ethylene/1-octene copolymer.
- 15 5) The multilayer barrier film as claimed in claim 3, wherein the at least one tie layer has a thickness in the range of $2\ \mu\text{m} - 40\ \mu\text{m}$.
- 20 6) The multilayer barrier film as claimed in claim 1, wherein the at least one polyolefin core layer is multilayer.
- 7) The multilayer barrier film as claimed in claim 1, wherein the at least one polyolefin core layer (**A**) comprises polymer having density in the range of $0.833\ \text{g/cm}^3 - 0.99\ \text{g/cm}^3$.
- 25 8) The multilayer barrier film as claimed in claim 1, wherein the at least one polyolefin core layer (**A**) has a thickness in the range of $1\ \mu\text{m} - 100\ \mu\text{m}$.
- 9) The multilayer barrier film as claimed in claim 1, wherein the at least one polyolefin layer (**C**) comprises polymer having density in the range of $0.833\ \text{g/cm}^3 - 0.990\ \text{g/cm}^3$.

- 10)The multilayer barrier film as claimed in claim 1, wherein the at least one polyolefin layer (**C**) has a thickness in the range of 3 μm – 100 μm .
- 11)The multilayer barrier film as claimed in claim 1, wherein the at least one polyolefin layer (**C**) is multilayer.
- 5 12)The multilayer barrier film as claimed in claim 1, wherein the at least one barrier layer (**B**) comprises a member selected from the group consisting of ethylene vinyl alcohol, polyamides, polyethylene terephthalate or combinations thereof.
- 13)The multilayer barrier film as claimed in claim 1, wherein the film has a
10 thickness in the range of 20 μm – 400 μm .
- 14)The multilayer film as claimed in any one of the claims 1-13, wherein the film has an oxygen transmission rate (OTR) equal to or less than 0.2 $\text{cm}^3/\text{m}^2/1$ day/1 atm, at a temperature in the range of 22 $^{\circ}\text{C}$ – 25 $^{\circ}\text{C}$ at relative humidity in the range of 0 – 90 % RH.
- 15 15)A process of preparing the multilayer barrier film as claimed in any one of the claims 1 – 14, wherein the film is prepared by a process selected from blown film process, cast film process, or lamination of blown or cast films.
- 16)A laminate comprising:
at least one print layer (**X**);
20 the multilayer barrier film as claimed in any one of the claims 1 - 13;
and
optionally at least one sealant layer (**Y**).
- 17)The laminate as claimed in claim 16, wherein the at least one print layer comprises a polymer selected from high density polyethylene, medium density
25 polyethylene, low density polyethylene, linear low-density polyethylene, polypropylene (PP), polypropylene copolymers, ethylene copolymers, and combinations thereof.
- 18)The laminate as claimed in claim 16, wherein the at least one sealant layer comprises a polymer selected from high density polyethylene, medium density

polyethylene, low density polyethylene, linear low-density polyethylene, and combinations thereof.

- 19) The laminate as claimed in claim 16, wherein the at least one print layer has a thickness in the range of 50 μm – 200 μm .
- 5 20) The laminate as claimed in claim 16, wherein the at least one sealant layer has a thickness in the range of 50 μm – 200 μm .
- 21) The laminate as claimed in any one of the claims 16-20, wherein the laminate reduces the oxygen transmission rate (OTR) by at least 2 times in comparison to single barrier layer of about same thickness.
- 10 22) The laminate as claimed in any one of the claims 16-21, wherein the laminate has an oxygen transmission rate (OTR) equal to or less than 0.2 $\text{cm}^3/\text{m}^2/1$ day/1 atm, at a temperature in the range of 22 $^{\circ}\text{C}$ – 25 $^{\circ}\text{C}$ at relative humidity in the range of 0 – 90% RH.
- 15 23) A process of preparing the laminate as claimed in any one of the claims 16-22, the process comprising laminating the layer by adhesive lamination or extrusion lamination.
- 24) An article comprising the multilayer barrier film as claimed in any one of the claims 1 – 14 or the laminate as claimed in any one of the claims 16 – 22.
- 20 25) Use of the multilayer barrier film as claimed in any one of the claims 1 – 14 or the laminate as claimed in any one of the claims 16 – 22 for a packaging material.
- 26) Use as claimed in claim 25, wherein packaging material is a lamitube.

ABSTRACT

BARRIER FILM AND IMPLEMENTATIONS THEREOF

The present disclosure discloses multilayer barrier (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has thickness in the range of 1 μm – 25 μm . It also discloses a process of preparing the multilayer barrier film. Additionally, a laminate comprising the multilayer barrier film of the present disclosure and a process of preparing the laminate is discussed. Furthermore, an article comprising the multilayer barrier film or the laminate of the present disclosure is also disclosed.

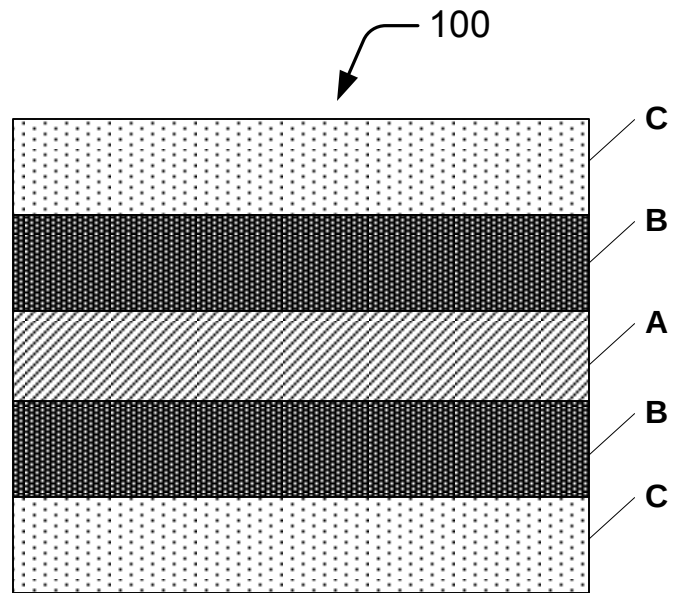


Fig.1

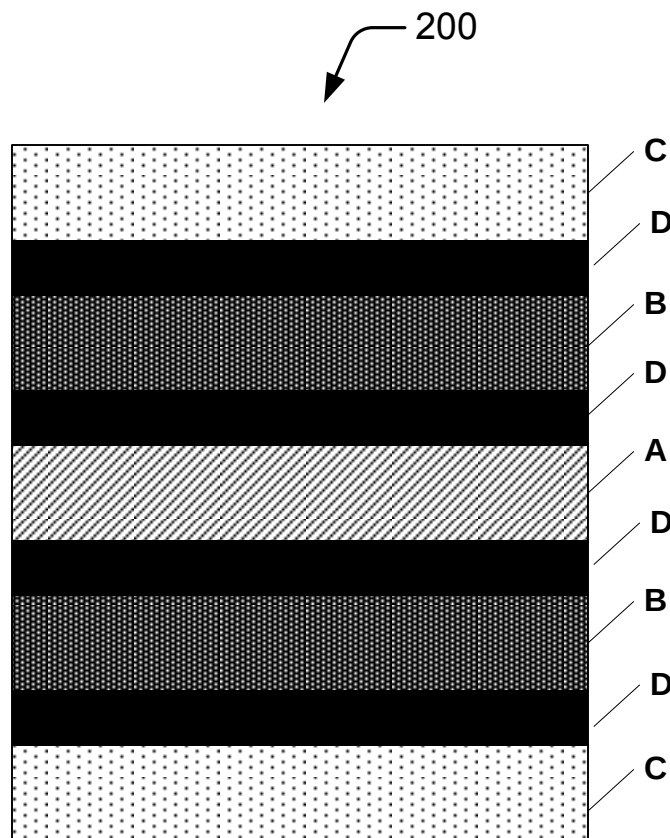


Fig.2

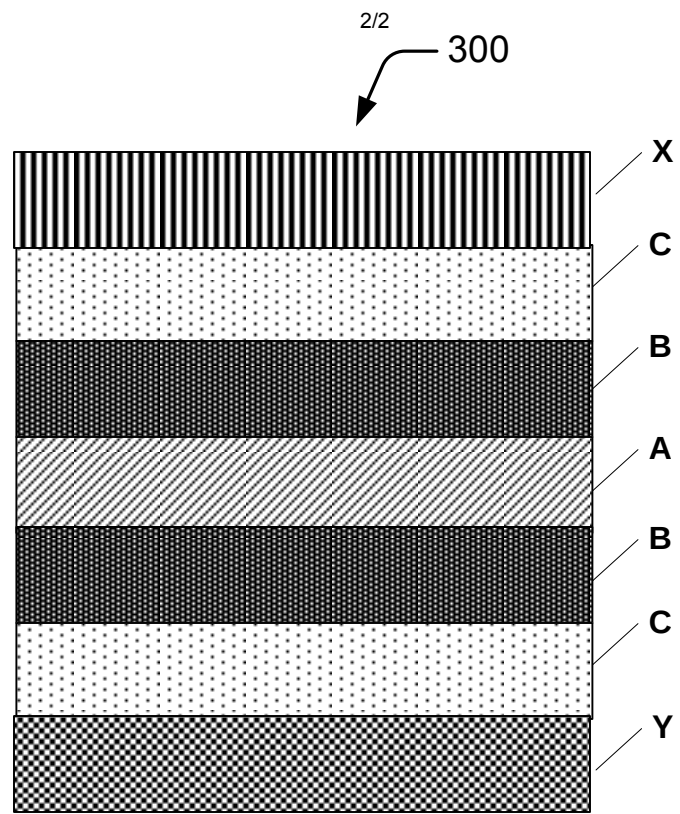


Fig.3

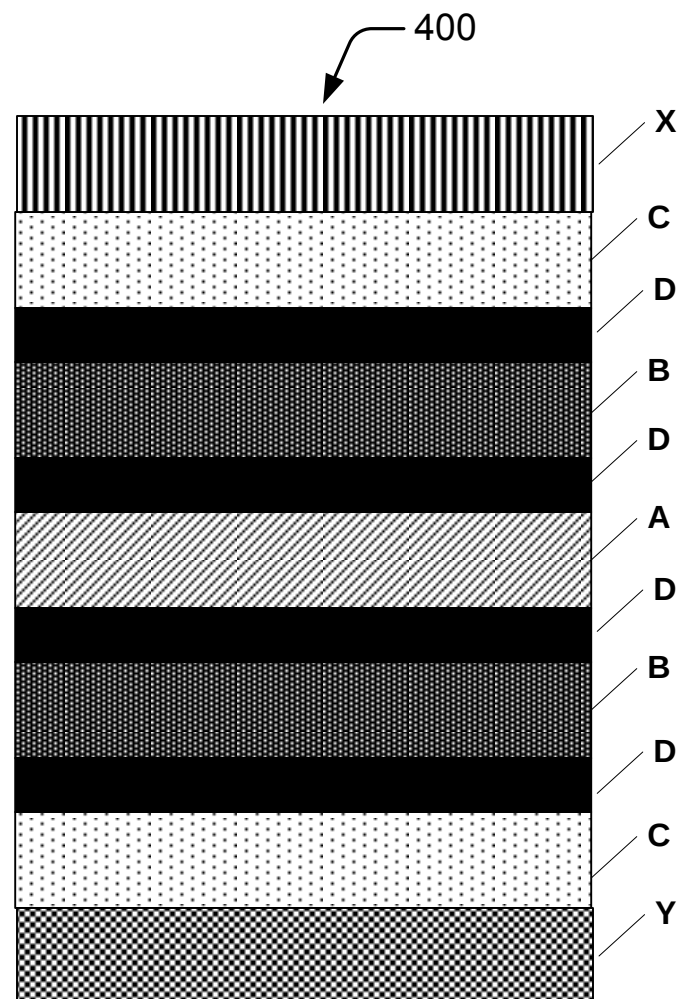


Fig.4

PCT POWER OF ATTORNEY

(Original in Electronic Form)

0-1	PCT Power of Attorney (for an international application filed under the Patent Cooperation Treaty) (PCT Rule 90.4)	
0-1-1	Prepared Using	ePCT-Filing Version 4.7.004 MT/FOP 20200527/1.1
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1-1-2	hereby appoints (appoint) the following person	RAE, Konpal B6/10, Safdarjung Enclave 110029 New Delhi India
1-1-3	hereby appoints (appoint) the following person	PHILLIPS, Prashant B6/10, Safdarjung Enclave 110029 New Delhi India
1-1-4	hereby appoints (appoint) the following person	PANDEYA, Jaya B6/10, Safdarjung Enclave 110029 New Delhi India
1-1-5	hereby appoints (appoint) the following person	SRINIVASAN, T. B6/10, Safdarjung Enclave 110029 New Delhi India
1-2	as	Agent
1-3	to represent the undersigned before	all the competent International Authorities
1-4	in connection with the international application identified below:	
1-4-1	Title of Invention	BARRIER FILM AND IMPLEMENTATIONS THEREOF
1-4-2	Applicant's or agent's file reference	PD036182PCT
1-4-3	International application number (if already available)	
1-4-4	filed with the following Office as receiving Office	Indian Patent Office (RO/IN)
1-5	and to make or receive payments on behalf of the undersigned	
2-1	Signature of applicant	/Hariharan Krishnan NAIR/
2-1-1	Name (LAST, First)	NAIR, Hariharan Krishnan
2-1-3	Capacity (if such capacity is not obvious from reading the request)	
3	Date	16 June 2020 (16.06.2020)

From the INTERNATIONAL BUREAU

PCTCOMMUNICATION IN CASES FOR WHICH
NO OTHER FORM IS APPLICABLE

To:

LAKSHMIKUMARAN, Malathi
B6/10, Safdarjung Enclave
New Delhi 110029
INDE

Date of mailing (day/month/year) 22 March 2021 (22.03.2021)	
Applicant's or agent's file reference PD036182PCT	REPLY DUE see paragraph 1 below
International application No. PCT/IN2020/050530	International filing date (day/month/year) 16 June 2020 (16.06.2020)
Applicant NAIR, Hariharan Krishnan	

1. ☐ REPLY DUE within months/days from the above date of mailing
☐ NO REPLY DUE, however, see below
☒ IMPORTANT COMMUNICATION
☐ INFORMATION ONLY

2. COMMUNICATION:

The International Bureau acknowledges receipt, on 17 March 2021 (17.03.2021) of the applicant's informal comments on the written opinion of the International Searching Authority (Form PCT/ISA/237).

Please be informed that unless an international preliminary report on patentability (Chapter II of the PCT) (Form PCT/IPEA/409) has been or is to be established, the International Bureau will communicate a copy of the submitted comments together with a copy of the international preliminary report on patentability (Chapter I of the PCT) (Form PCT/IB/373) to each designated Office in accordance with Rule 93bis.1 but not before the expiration of 30 months from the priority date. As soon as the international application has been published, a copy of the submitted comments will also be made publicly available on WIPO's PATENTSCOPE web site.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Cruz Juan e-mail pct.team1@wipo.int Telephone No. +41 22 338 74 01
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PCT Application No.: PCT/IN2020/050530
Filed on:16-Jun-20
Priority Application No.: 201921051881
Priority Date: 13-Dec-2019
Title: BARRIER FILM AND IMPLEMENTATIONS THEREOF
Applicant(s): NAIR, Hariharan Krishnan
L&S Ref. No.: PD036182PCT

Primarily, the Applicant thanks the ISA for acknowledging the novelty and industrial applicability of the claimed invention as recited in claims 1-26. Moreover, the inventive step of the as-filed claims 19, 20, and 26 has been acknowledged by the ISA. However, inventive step objections have been raised on the claims 1-18, and 21-25. The Applicant provides the following comments to address the objections on inventive step:

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement 2.3) The subject matter of claims 1-18, and 21-25 has been considered to lack inventive step under Article 33(3) PCT, being anticipated in view of the following cited documents:

Document	Category
D1 US 9662863 B2 (TETRA LAVAL HOLDINGS & FINANCE [CH]) 30 May 2017 (2017-05-30) (abstract; column 5, lines 51-55; column 6, lines 1-55; column 7, lines 23-27)	Y
D2 US 2002/0155308 A1 (EXXONMOBIL OIL CORP [US]) 24 October 2002 (2002-10-24) (abstract; paragraph [0025]; claim 10)	Y
D3 WO 1994/23941 A1 (MOBIL OIL CORP [US]) 27 October 1994 (1994-10-27) (abstract; page 1, lines 19-29)	Y
D4 WO 2002/060625 A2 (INT PAPER CO [US]) 08 August 2002 (2002-08-08) (abstract; paragraphs [0041, 0042, 0057]; example 1; figure 2)	Y
D5 US 6720046 B2 (TETRA LAVAL HOLDINGS & FINANCE [CH]) 13 April 2004 (2004-04-13) (column 3, lines 13-20; column 4, lines 10-6; figure 2)	Y
D6 WO 2002/072347 A2 (CRYOVAC INC [US]) 19 September 2002 (2002-09-19) (figure 2; page 6, lines 27-30; page 9, lines 10-16; page 17, lines 24-25;	Y

INVENTIVE STEP:

The Applicant disagrees with the assessment of the Examiner provided in Para 2.3 of the WO-ISA and submits the following rebuttal:

Instant Application:

The instant Application discloses a multilayer barrier film (F) comprising: (a) at least one polyolefin core layer (A); (b) at least one barrier layer (B) on both the sides of the core layer; and (c) at least one polyolefin layer (C) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has thickness in the range of 1 μm – 25 μm . It also discloses to a process of manufacturing such a multilayer barrier film, a laminate comprising the barrier film, and a process of preparing the laminate. It further discloses to an article comprising the barrier film or the laminate. Furthermore, the instant Application discloses the use of the barrier film or the laminate in an article/packaging material.

The instant Application provides multilayer barrier film which helps in increasing the barrier properties of the film using the same or lesser thickness of the at least one barrier layer. The structure of the multilayer barrier film is such that even with reduced thickness of the barrier layer, the barrier properties are surprisingly enhanced, i.e., replacing a single barrier layer of certain thickness with two barrier layers separated by a polyolefin core layer results in a film with enhanced barrier properties, i.e., reduction of OTR approximately at least 2 - 15 times.

Document D1:

The Document D1 relates to a biaxially oriented multilayer, barrier polymer film, having gas barrier properties and consisting of polymer layers, comprising a polyolefin core layer and a barrier surface layer of ethylene vinyl alcohol (EVOH) on a first side of the core layer. It is submitted that the Document D1 relates to biaxially oriented multi-layer film whereas the claimed invention is a multilayer barrier film without biaxial orientations. Therefore, the Document D1 is entirely an irrelevant document to assess the inventive step.

Moreover, the Document D1 teaches a vapour deposition coated barrier film to have improved gas barrier properties at high humidity.

The problem addressed by the Document D1 is when incorporating a barrier layer into a laminated packaging material, and further re-shaping and folding the material into a filled packaging container in a filling machine, stress and tensions may affect the barrier layer causing it to crack or otherwise become defective thus allowing oxygen molecules to migrate through the layer. To avoid these problems Document D1 **provides biaxially oriented**, multilayer polymer barrier films that exhibit excellent oxygen barrier properties while being less susceptible than foil material to crack or other defects.

It is submitted that the underlying problem of the claimed invention and the Document D1 is different and there is nothing in the Document D1 that would lead a person skilled in the art to arrive at the claimed invention.

Moreover, the Document D1 does not teach or suggest a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has thickness in the range of 1 μm – 25 μm . Thus, the claimed invention is non-obvious in view of the Document D1.

Document D2:

The Document D2 discloses a biaxially oriented multi-layer film comprises: (a) a core layer comprising a syndiotactic propylene homopolymer; and (b) at least one additional layer adjacent to the core layer comprising a polymer which is an ethylene or a propylene homopolymer, ethylene copolymer or terpolymer containing comonomers of propylene and/or butene-1.

Though, the Document D2 discloses a five-layered structure ‘ABCDE’ as similar to that of the Fig.1 of the present application, but the Document D2 has no specific disclosure with respect to the barrier layers on either side of the core layer.

The five-layered structure as disclosed in the Document D2 as per Para [0025] is

A	Further outer layer or skin layer of ethylene-propylene-butene-1 terpolymer
B	Outer layer (tie layer OR an intermediate layer of conventional isotactic polypropylene (Fina 3371))

C	Core layer comprising at least about 90% of a syndiotactic polypropylene polymer
D	Outer layer (tie layer OR an intermediate layer)
E	Further outer layer or skin layer

Moreover, the multilayer film of the Document D2 is biaxially oriented film which is entirely different from the multilayer barrier film of the claimed invention.

It is submitted that the Document D2 relates to a biaxially oriented multi-layer film having a core layer of **syndiotactic polypropylene** and additional layers, **wherein the shrinkage of the biaxially oriented multilayer film at 135 °C. is less than 25% in the machine and transverse directions**. The syndiotactic propylenepolymer used in the Document D2 have melt flows of about 4 and 7 g/10min as measured I accordance with the standard ASTM D1238 method. In contrast, multilayer barrier film (F) of the claimed invention comprises a polyolefin core layer and on both the sides of the core layer is a barrier layer which individually has thickness in the range of 1 µm – 25 µm. The Document D2 fails to disclose such feature.

Furthermore, it is submitted that Document D2 relates to biaxially oriented multi-layer film whereas the claimed inventios is a multilayer barrier film without biaxial orientations. Therefore, the Document D2 is entirely an irrelevant document to assess the inventive step and moreover it teaches away from the claimed invention.

It is submitted that the cherry-picking portions from the Document D2 to support the hindsight reconstruction of the claimed invention is not allowed. It is further submitted that while assessing inventive step, a prior art reference must be considered in its entirety, i.e., as a whole, including portions that would teach away from the claimed invention. Therefore, the claimed invention is non-obvious and inventive in view of the Document D2.

Document D3

The Document D3 was cited to demonstrate that the oxygen transmission rate of less than 0.2 cm³/m²/ 1 day/1 atm, which is similar to the disclosure of the present application. The Applicant in this regard submits that the multilayer packaging film of the Document D3 is structurally different from the claimed invention.

It is submitted that, nothing in the Document D3 would lead a person skilled in the art seeking to solve the above-mentioned problem to arrive at the claimed invention. There is no teaching or suggestion in the Document D3 to arrive at a multilayer barrier film (F) comprises a polyolefin core layer and on both the sides of the core layer have a barrier layer which individually has thickness in the range of 1 μm – 25 μm of the instant Application. On the contrary, the Document D3 specifically teaches a biaxially oriented multilayer film structure comprising: (A) a core layer of polypropylene having dispersed therein microspheres sufficient in size and quantity so that, during orientation, the core layer becomes opaque, which either includes a minor proportion of a maleic anhydride modified polypropylene blended therein and/or has a skin layer (B) of maleic anhydride modified polypropylene on one side; (C) a layer of ethylene vinyl alcohol (EVOH) copolymer on the maleic anhydride modified polypropylene containing layer, and (D) on the other side of the core layer a heat sealable or printable skin layer; said structure comprising polypropylene of greater orientation in the transverse direction.

Hence, a person skilled in the art, in view of the Document D3 alone or in any combination would, not arrive at the claimed invention.

Document D4

The Document D4 relates to laminate structure for both packaging and non-packaging applications, including a five-layer coextrusion composite containing an EVOH/polyolefin composite barrier layer coated or applied to a paper or paperboard substrate. Moreover, the Document D4 teaches **EVOH/polyolefin blend layer** (a blend of an ethylene vinyl alcohol copolymer having 44% ethylene moiety and a low-density polyethylene polymer). The blend barrier, which is part of a five-layer coextrusion composite layer provides improved oxygen and moisture barrier characteristics to a package, prepared from such a laminated structure, as well as improved rigidity and heat resistance, thereby providing longer shelf life and excellent flavor retention to the stored contents as well as improved dimensional stability to the cartons, package or containers, at a reduced cost.

Similar to the Document D3, D4 also does not teach or suggest a multilayer barrier film (F) comprising a polyolefin core layer and on both the sides of the core layer have a barrier layer which individually has thickness in the range of 1 μm – 25 μm .

A person skilled in the art would not search in the Document D4 for answers to the objective technical problem as the Document D4 focusses on improved dimensional stability to the cartons, package or containers, at a reduced cost. The Paper or paperboard-based laminate structure have entirely different mechanism than the ones without them. Moreover, the Document D4 teaches away from having different layers of EVOH and polyolefin as using a blend of EVOH/polyolefin as a layer is outside the scope of separate layer structural configuration.

In view of the above, it is submitted that while assessing inventive step, a prior art reference must be considered in its entirety, i.e., as a whole, including portions that would teach away from the claimed invention. Therefore, the claimed invention is non-obvious and inventive in view of the Document D4.

Document D5

The Document D5 discloses low scalping laminate material for packaging. The aim of the document D5 is to improve upon a cost-effective laminate material while retaining mechanical stability, non-scalping properties and a high oxygen barrier, i.e., to reduce material without increasing manufacturing difficulties, or removing/damaging product characteristics. The objectives have been achieved by rearrangement/removal/changes to the several layers of inside polymer coatings to the core layer, which in turn is achieved by single coextrusion and/or multilayer extrusion so as to keep the inner layer thin (light weight). It is submitted that the food packaging of the Document D5 includes **a core layer of paper or paperboard**, a polymeric coating applied to one side of the core layer and a combination of layers disposed on an opposing side of the core layer. In contrast, no such paper or paperboard layer is present in the claimed barrier film. It is thus submitted that the barrier film of the claimed invention and laminate material of the Document D5 are structurally different.

Moreover, the Document D5 teaches having a core layer of paper or paperboard to provide mechanical and configurational stability (Refer Col 1; lines 11-18). Therefore, a person skilled in the art after going through Document D5 will consider paper or paperboard core layer as an essential feature. It is thus, submitted that Document D5 in fact teaches away from the claimed invention.

In view of the foregoing discussion claimed invention is non-obvious and inventive in view of the Document D5.

Document D6

The Document D6 discloses a packaging laminate useful as a lidstock comprises first and second films, and an image between the first and second films.

The Document D6 has been cited to demonstrate that a laminate comprising the sealant film 12 and the barrier film 14 of which, both include one or more additional layers, such as a tie layer (C), core or bulk layers (B) and sealant layer (A).

The Applicant respectfully disagrees with the several elements of the Examiner's assessment above, at least insofar as some of the components of claim 1 alleged by the Examiner to be disclosed in Document D6 have been mosaics from discrete sections of the Document D6 which describe lidstock laminate entirely different from the claimed invention.

The Applicant wishes to draw attention to the following points :

The problem to be solved by the Document D6 is to include a printed image (i.e., in formative or decorative elements in a lidstock laminate so that the image is protected.

In contrast the problem to be solved by the claimed invention is to provide barrier films with enhanced barrier efficiency, wherein the claimed invention provides multilayer barrier film which helps in increasing the barrier properties of the film using the same or lesser thickness of the at least one barrier layer. The structure of the multilayer barrier film is such that even with reduced thickness of the barrier layer, the barrier properties are surprisingly enhanced, i.e., replacing a single barrier layer of certain thickness with two barrier layers separated by a polyolefin core layer results in a film with enhanced barrier properties. Enhanced barrier properties herein refer to reduction of OTR approximately at least 2 - 15 times.

Thus, it is submitted that the problem addressed by the Document D6 is entirely different from the objectives of the claimed invention and a person skilled in the art will never view Document D6 as a relevant document.

In view of the above the claimed invention is non-obvious and inventive in view of the Document D6.

Overall, none of the Documents D1-D6 provide any specific teaching or suggestion to arrive at a multilayer barrier film (**F**) comprising: (a) at least one polyolefin core layer (**A**); (b) at least one barrier layer (**B**) on both the sides of the core layer; and (c) at least one polyolefin layer (**C**) adjacent to the at least one barrier layer, wherein the at least one barrier layer individually has thickness in the range of 1 μm – 25 μm as claimed in the instant Application.

All the cited documents motivate to prepare different types of laminate/films with biaxial orientation or with paper or paperboard layer. A person skilled in the art would require carrying out significant number of experiments to arrive at the multilayer barrier film of the claimed invention. In order to arrive at the present invention, a person skilled in the art has to first of all make the innumerable modification in the structural features as well as process steps taught in the cited documents, which is in no way obvious for a skilled artisan due to differences in the structures of the laminate/films disclosed in the Documents D1-D6 and that of the instant Application.

Further, the instant Application provides multilayer barrier film which helps in increasing the barrier properties of the film using the same or lesser thickness of the at least one barrier layer. The structure of the multilayer barrier film is such that even with reduced thickness of the barrier layer, the barrier properties are surprisingly enhanced, i.e., replacing a single barrier layer of certain thickness with two barrier layers separated by a polyolefin core layer results in a film with enhanced barrier properties, i.e., reduction of OTR approximately at least 2 - 15 times

The barrier film with enhances barrier properties have been shown in Examples 1 to 3, Tables 1 to 4 of the as-filed specification of the instant Application. Thus, the multilayer barrier film of the claimed invention is technically advanced. Hence, the instant Application is inventive over the Documents D1-D6, alone or in combination.

The Applicant submits that none of the cited reference Documents D1-D6 alone or in combination “teach”, “suggest” or “motivate” the subject-matter as claimed in the present invention and it is

non-obvious for a person skilled in the art to arrive at the present invention. Thus, in view of the foregoing arguments, the Applicant submits that the subject-matter as claimed in the present invention is inventive over the cited documents.

Box No. VIII Certain observations on the international application

1. Clerical error '0.0.833' instead of '0.833' in paragraph [0045] of the description shall be corrected.

Comments: The Applicant will correct the typographical error while entering National phases.