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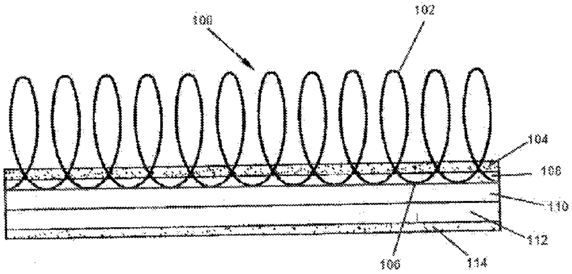

FIG. 1

(57) Abstract: This disclosure relates to a carpet having fluid barrier properties. The disclosed carpet comprises: (a) a greige good comprising: i) a primary backing component having a face surface and a back surface; ii) a plurality of fibers attached to the primary backing component and extending from the face surface of the primary backing component; (b) an adhesive composition applied to the back surface of the primary backing component; (c) a secondary backing having a first surface and a second surface, wherein the first surface of the secondary backing is adhered to the back surface of the primary backing component by the adhesive composition; and (d) a polymer film disposed on the second surface of the secondary backing. In some aspects, a first portion of the polymer film is adhered to the primary backing component and a second portion of the polymer film is adhered to the second surface of the secondary backing.

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CARPET WITH FLUID BARRIER PROPERTIES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of priority to co-pending United States provisional patent application serial number 62/187,628, filed July 1, 2015. The entire disclosure of this provisional application is incorporated by reference herein for all purposes.

FIELD OF THE INVENTION

[0002] The present invention pertains to carpets and carpet products that provide a fluid barrier to fluid penetration to the under surface upon which the carpet is positioned. More particularly, the present invention pertains to carpets and carpet products having a backing including a barrier impervious to fluid penetration. The present invention further pertains to carpets or carpet products having a structure that prevents fluid penetration through the carpet. The present invention further pertains to methods of making such carpet or carpet products as described herein.

BACKGROUND OF THE INVENTION

[0003] Carpets are generally produced by tufting or needle punching carpet yarns into and through a primary backing component. The primary backing component is typically comprised of a woven or non-woven material or a combination of such materials. It is common in the carpet industry to also apply a secondary backing that can include a woven material. In some aspects, the secondary backings can include a foam material, which can also act as the cushion for the carpet.

[0004] When a fluid, such as a beverage, accidentally spills onto the surface of the carpet, the fluid flows through the carpet to the back of the carpet and soaks all the way through contaminating the underlying surfaces. Fluid penetration of carpets also presents a difficult situation for anyone who keeps a dog or a cat as a pet where a fluid such as pet urine is likely to contact the carpet. Fluid penetration is also an issue in healthcare facilities where penetrations of blood, urine, or other bodily fluids into and through a carpet represent a problem. In hospitality applications, such as restaurants, fluid penetration and resultant staining is a constant dilemma. It is universally recommended by the carpet manufacturers to clean up spills promptly, but it is also generally recognized that it is highly impracticable to clean and absorb the spills before at least some of the fluid has penetrated though the backing to the sub-floor. This often leads to the development of permanent odors, stains, formation and entrapment of bacteria, and other potentially hazardous conditions. The fluid can also lead to degradation or destruction of the carpet structure itself.

[0005] Accordingly, there is a need for carpet and carpet products that are resistant to fluid penetration. It would be further desirable to have a carpet or a carpet product having a backing including a barrier impervious to fluid penetration. Still further, there is a need for methods of manufacture of carpet or carpet products that are resistant to fluid penetration. These needs and other needs are at least partially satisfied by the present invention.

SUMMARY OF THE INVENTION

[0006] In accordance with the purpose(s) of the invention, as embodied and broadly described herein, the invention, in one aspect, relates to a carpet comprising: (a) a greige good comprising: i) a primary backing component having a face surface and a back surface; ii) a plurality of fibers attached to the primary backing component and extending from the face surface of the primary backing component; (b) an adhesive composition applied to the back surface of the primary backing component; (c) a secondary backing having a first surface and a second surface, wherein the first surface of the secondary backing is adhered to the back surface of the primary backing component by the adhesive composition; and (d) a polymer film disposed on the second surface of the secondary backing. In some aspects, a first portion of the polymer film is adhered to the primary backing component and a second portion of the polymer film is adhered to the second surface of the secondary backing.

[0007] Also disclosed herein is a carpet comprising: (a) a greige good comprising: i) a primary backing component having a face surface and a back surface; ii) a plurality of fibers attached to the primary backing component and extending from the face surface of the primary backing component; (b) an adhesive composition applied to the back surface of the primary backing component; (c) a woven tape-tape yarn secondary backing having a first surface and a second surface, wherein the first surface of the secondary backing is facing the back surface of the primary backing component; and (d) a polymer film disposed on the second surface of the secondary backing. In some aspects, a first portion of the polymer film is adhered to the primary backing component and a second portion of the polymer film is adhered to the second surface of secondary backing.

[0008] Further disclosed herein is a method of making a carpet comprising: (a) providing a greige good comprising: i) a primary backing component having a face surface and a back surface; ii) a plurality of fibers attached to the primary backing component and extending from the face surface of the primary backing component; (b) applying an adhesive composition to the back surface of the primary backing component; (c) co-laminating a secondary backing and a polymer film to the back surface of the primary backing component such that i) a first surface of the secondary backing is adhered to the back surface of the primary backing component by the adhesive composition and the polymer film is adhered to the back or second surface of the secondary backing. In some aspects, the co-lamination step results in a first portion of the polymer film being adhered to the primary backing component and a second portion of the polymer film being adhered to a second surface of the secondary backing.

[0009] Additional aspects of the invention will be set forth, in part, in the detailed description, and claims which follow, and in part will be derived from the detailed description, or can be learned by practice of the invention. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention as disclosed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] **FIGURE 1** shows an exemplary inventive carpet structure as disclosed and described herein.

[0011] **FIGURE 2** shows a schematic illustration of an exemplary system and method for making a carpet as disclosed and described herein.

[0012] **FIGURE 3** shows results of the British Spill Test on exemplary carpet products having a tape-tape secondary backing (A) and a tape-spun secondary backing (B) as described in Experiment 1.

[0013] **FIGURE 4** shows a close up image of an exemplary tape-tape secondary backing.

[0014] **FIGURE 5** shows a close up image of an exemplary tape-spun secondary backing.

[0015] **FIGURE 6** shows an illustration of the testing performed in Experiment 2 wherein two test specimens of secondary backing: a tape-spun secondary backing (top) and a tape-tape secondary backing (bottom), were evaluated for wicking characteristics.

DETAILED DESCRIPTION OF THE INVENTION

[0016] The present invention can be understood more readily by reference to the following detailed description, examples, drawings, and claims, and their previous and following description. However, before the present compositions, articles, devices, systems, and/or methods are disclosed and described, it is to be understood that this invention is not limited to the specific compositions, articles, devices, systems, and/or methods disclosed unless otherwise specified, as such can, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular aspects only and is not intended to be limiting.

[0017] The following description of the invention is also provided as an enabling teaching of the invention in its best, currently known aspect. To this end, those of ordinary skill in the relevant art will recognize and appreciate that changes and modifications can be made to the various aspects of the invention described herein, while still obtaining the beneficial results of the present invention. It will also be apparent that some of the desired benefits of the present invention can be obtained by selecting some of the features of the present invention without utilizing other features. Accordingly, those of ordinary skill in the relevant art will recognize that many modifications and adaptations to the present invention are possible and can even be desirable in certain circumstances and are thus also a part of the present invention. Thus, the following description is provided as illustrative of the principles of the present invention and not in limitation thereof.

[0018] Various combinations of elements of this disclosure are encompassed by this invention, *e.g.* combinations of elements from dependent claims that depend upon the same independent claim.

[0019] Moreover, it is to be understood that unless otherwise expressly stated, it is in no way intended that any method set forth herein be construed as requiring that its steps be performed in a specific order. Accordingly, where a method claim does not actually recite an order to be followed by its steps or it is not otherwise specifically stated in the claims or descriptions that the steps are to be limited to a specific order, it is no way intended that an order be inferred, in any respect. This holds for any possible non-express basis for interpretation, including: matters of logic with respect to arrangement of steps or operational flow; plain meaning derived from grammatical organization or punctuation; and the number or type of aspects described in the specification.

[0020] All publications mentioned herein are incorporated herein by reference to disclose and describe the methods and/or materials in connection with which the publications are cited.

[0021] It is also to be understood that the terminology used herein is for the purpose of describing particular aspects only and is not intended to be limiting. As used in the specification and in the claims, the term “comprising” may include the aspects “consisting of” and “consisting essentially of.” Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. In this specification and in the claims which follow, reference will be made to a number of terms which shall be defined herein.

[0022] As used herein, the singular forms "a," "an" and "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to a “polymer” includes aspects having two or more polymers unless the context clearly indicates otherwise.

[0023] Ranges can be expressed herein as from “about” one particular value, and/or to “about” another particular value. When such a range is expressed, another aspect includes from the one particular value and/or to the other particular value. Similarly, when values are expressed as approximations, by use of the antecedent “about,” it will be understood that the particular value forms another aspect. It will be further understood that the endpoints of each of the ranges are significant both in relation to the other endpoint, and independently of the other endpoint. It is also understood that there are a number of values disclosed herein, and that each value is also herein disclosed as “about” that particular value in addition to the value itself. For example, if the value “10” is disclosed, then “about 10” is also disclosed. It is also understood that each unit between two particular units are also disclosed. For example, if 10 and 15 are disclosed, then 11, 12, 13, and 14 are also disclosed.

[0024] As used herein, the terms "optional" or "optionally" mean that the subsequently described event or circumstance may or may not occur, and that the description includes instances where said event or circumstance occurs and instances where it does not.

[0025] References in the specification and concluding claims to parts by weight of a particular element or component in a composition or article, denotes the weight relationship between the element or component and any other elements or components in the composition or article for which a part by weight is expressed. Thus, in a composition or a selected portion of a composition containing 2 parts by weight of component X and 5 parts by weight component Y, X and Y are present at a weight ratio of 2:5, and are present in such ratio regardless of whether additional components are contained in the composition.

[0026] A weight percent of a component, or weight %, or wt. %, unless specifically stated to the contrary, is based on the total weight of the formulation or composition in which the component is included.

[0027] "Carpet" is used herein in the manner as would be recognized by one of ordinary skill in the art. The definition of carpet as used herein includes any known in the art carpet products. As an example, and without limitation, the term "carpet" includes carpet tiles, rugs, and turfs. As used herein, and unless the context clearly indicates otherwise, the term carpet is also used to generically include broadloom carpets and area rugs. To that end, "broadloom carpet" means a broadloom textile flooring product manufactured for and intended to be used in roll form.

[0028] The definition of carpet as used herein does not include products that would be known to one of ordinary skill in the art as "resilient flooring." As an example, products that fall under the category of resilient flooring include, but are not limited to, linoleum, vinyl tiles, cork tiles, rubber tiles and floor mats.

[0029] The term "oligomer" as used herein refers to a molecule that consists of a few monomer units than a polymer. Exemplary oligomers include dimmers, trimers and tetramers.

[0030] The term "fiber" as used herein includes fibers of extreme or indefinite length (i.e. filaments) and fibers of short length (i.e., staple fibers).

[0031] The term “yarn” as used herein refers to a continuous strand, length, or bundle of fibers. The fibers can be any type of fiber as described herein.

[0032] As used herein, the term “copolymer” refers to a polymer formed from two or more different repeating units (monomer residues). By way of example and without limitation, a copolymer can be an alternating copolymer, a random copolymer, a block copolymer, or a graft copolymer.

[0033] The term “linear” as used to describe ethylene polymers is used herein to mean the polymer backbone of the ethylene polymer lacks measurable or demonstrable long chain branches, e.g., the polymer is substituted with an average of less than 0.01 long branch/1000 carbons.

[0034] The term “homogeneous ethylene polymer” as used to describe ethylene polymers is used in the conventional sense in accordance with the original disclosure by Elston in U.S. Pat. No. 3,645,992, the disclosure of which is incorporated herein by reference. As defined herein, homogeneous ethylene polymers include both substantially linear ethylene polymers and homogeneously branched linear ethylene.

[0035] Homogeneously branched ethylene polymer is homogeneous ethylene polymer that refers to an ethylene polymer in which the monomer or comonomer is randomly distributed within a given polymer or interpolymer molecule and wherein substantially all of the polymer or interpolymer molecules have substantially the same ethylene to comonomer molar ratio with that polymer or interpolymer.

[0036] Alternatively, homogeneously branched ethylene polymers can be defined as homogeneous ethylene polymers that possess short chain branches and characterized by a relatively high short chain branching distribution index (SCBDI) or relatively high composition distribution branching index (CDBI). That is, the ethylene polymer has a SCBDI or CDBI greater than or equal to 50 percent, greater than or equal to 70 percent, or greater than or equal to 90 percent and essentially lack a measurable high density (crystalline) polymer fraction.

[0037] In the aspects wherein the homogeneously branched ethylene polymers are characterized by the short chain branching distribution index or composition distribution branching index, the SCBDI or CDBI can be defined as the weight percent of the polymer molecules having a comonomer content within 50 percent of the median total molar comonomer content and represents a comparison of the comonomer distribution in the polymer to the comonomer distribution expected for a Bernoullian distribution. The SCBDI or CDBI of polyolefins can be conveniently calculated from data obtained from techniques known in the art, such as, for example, temperature rising elution fractionation (abbreviated herein as "TREF") as described, for example, by Wild et al., *Journal of Polymer Science, Poly. Phys. Ed.,* Vol. 20, p. 441 (1982), L. D. Cady, "The Role of Comonomer Type and Distribution in LLDPE Product Performance," SPE Regional Technical Conference, Quaker Square Hilton, Akron, Ohio, Oct. 1-2, pp. 107-119 (1985), or in U.S. Pat. Nos. 4,798,081 and 5,008,204, the disclosures of all of which are incorporated herein by reference. In some aspects, the comonomer distribution of the polymer and SCBDI or CDBI are determined using ^{13}CNMR analysis in accordance with techniques described, for example, in U.S. Pat. No. 5,292,845 and by J. C Randall in Rev. Macromol. Chem. Phys., C29, pp. 201-317, the disclosures of which are incorporated herein by reference.

[0038] In some aspects, the terms "homogeneously branched linear ethylene polymer" and "homogeneously branched linear ethylene/α-olefin polymer" means that the olefin polymer has a homogeneous or narrow short branching distribution but does not have long chain branching. That is, the linear ethylene polymer is a homogeneous ethylene polymer characterized by an absence of long chain branching. Such polymers can be made using polymerization processes (e.g., as described by Elston in U.S. Pat. No. 3,645,992) which provide a uniform short chain branching distribution (i.e., homogeneously branched). Homogeneously branched linear ethylene polymers are typically characterized as having a molecular weight distribution, M_w/M_n, of less than about 3, less than about 2.8, or less than about 2.3. Commercial examples of suitable homogeneously branched linear ethylene polymers include those sold by Mitsui Petrochemical Industries as Tafmer™ resins and by Exxon Chemical Company as Exact™ resins and Exceed™ resins. Alternatively, the terms "homogeneously branched linear ethylene polymer" and "homogeneously branched linear ethylene/α-olefin polymer" means that the olefin polymer has a relatively high SCBDI or CDBI.

[0039] The terms "homogeneous linearly branched ethylene polymer" or "homogeneously branched linear ethylene/α-olefin polymer" do not refer to high pressure branched polyethylene which is known to those skilled in the art to have numerous long chain branches. The term “homogeneous linear ethylene polymer” generically refers to both linear ethylene homopolymers and to linear ethylene/α-olefin interpolymers. A linear ethylene/α-olefin interpolymer possesses short chain branching and the α-olefin is typically at least one C_3-C_{20} α-olefin (e.g., propylene, 1-butene, 1-pentene, 4-methyl-1-pentene, 1-hexene, and 1-octene). In other aspects the polyethylenes that are suitable for use in the present invention are interpolymers of ethylene with at least one C_3-C_{20} α-olefin and/or C_4 -C_{18} diolefin. Copolymers of ethylene and α-olefin of C_3-C_{20} carbon atoms can be used.

[0040] The term “interpolymer” is used herein to indicate a copolymer, or a terpolymer, or the like, where at least one other comonomer is polymerized with ethylene to make the interpolymer. Suitable unsaturated comonomers useful for polymerizing with ethylene include, for example, ethylenically unsaturated monomers, conjugated or non-conjugated dienes, polyenes, *etc.* Examples of such comonomers include C_3-C_{20} α-olefins as propylene, isobutylene, 1-butene, 1-hexene, 4-methyl-1-pentene, 1-heptene, 1-octene, 1-nonene, 1-decene, 1,9-decadiene and the like. Other suitable monomers include styrene, halo- or alkyl-substituted styrenes, tetrafluoroethylene, vinylbenzocyclobutane, 1,4-hexadiene, 1,7-octadiene, and cycloalkenes, *e.g.*, cyclopentene, cyclohexene and cyclooctene.

[0041] When used in reference to an ethylene homopolymer (i.e., a high density ethylene polymer not containing any comonomer and thus no short chain branches), the term “homogeneous ethylene polymer” or “homogeneous linear ethylene polymer” means the polymer was made using a homogeneous catalyst system such as, for example, that described Elston or Ewen or those described by Canich in U.S. Pat. Nos. 5,026,798 and 5,055,438, or by Stevens et al. in U.S. Pat. No. 5,064,802, the disclosures of all three of which are incorporated herein by reference.

[0042] The terms “substantially linear ethylene polymer” or “SLEP,” are used interchangeably, and refer specifically to homogeneously branched ethylene polymers that have long chain branching. The term does not refer to heterogeneously or homogeneously branched ethylene polymers that have a linear polymer backbone. For substantially linear ethylene polymers, the long chain branches have the same comonomer distribution as the polymer backbone, and the long chain branches can be as long as about the same length as the length of the polymer backbone to which they are attached. The polymer backbone of substantially linear ethylene polymers is substituted with about 0.01 long chain branches/1000 carbons to about 3 long chain branches/1000 carbons, from about 0.01 long chain branches/1000 carbons to about 1 long chain branches/1000 carbons, and from about 0.05 long chain branches/1000 carbons to about 1 long chain branches/1000 carbons.

[0043] Long chain branching is defined herein as a chain length of at least 6 carbons, above which the length cannot be distinguished using ^{13}C nuclear magnetic resonance spectroscopy. The presence of long chain branching can be determined in ethylene homopolymers by using ^{13}C nuclear magnetic resonance (NMR) spectroscopy and is quantified using the method described by Randall (*Rev. Macromol. Chem. Phys.,* C29, V. 2&3, p. 285-297), the disclosure of which is incorporated herein by reference.

[0044] Substantially linear ethylene polymers are homogeneously branched ethylene polymers and are disclosed in U.S. Pat. No. 5,272,236 and U.S. Pat. No. 5,278,272, the disclosures of which are incorporated herein by reference. Homogeneously branched substantially linear ethylene polymers are available from The Dow Chemical Company as AFFINITY™ polyolefin plastomers and from Dupont Dow Elastomers JV as ENGAGE™ polyolefin elastomers. Homogeneously branched substantially linear ethylene polymers can be prepared via the solution, slurry, or gas phase polymerization of ethylene and one or more optional α-olefin comonomers in the presence of a constrained geometry catalyst, such as the method disclosed in European Patent Application 416,815-A, the disclosure of which is incorporated herein by reference. In some aspects, a solution polymerization process is used to manufacture the substantially linear ethylene polymer used in the present invention.

[0045] The term "heterogeneously branched ethylene polymer" refers to a polymer having a distribution of branching different from and broader that the homogeneous branching ethylene /α-olefin interpolymer at similar molecular weight. In further aspects, the "heterogeneous" and "heterogeneously branched" mean that the ethylene polymer is characterized as a mixture of interpolymer molecules having various ethylene to comonomer molar ratios. Alternatively, heterogeneously branched linear ethylene polymers can be defined as having a SCBDI less than about 50 % and more typically less than about 30 %. HBEPs and SLEPs also differ from the class of polymers known conventionally as heterogeneously branched traditional Ziegler polymerized linear ethylene interpolymers, for example, ultra-low density polyethylene ("ULDPE"), very low density polyethylene ("VLDPE"), linear low density polyethylene ("LLDPE") medium density polyethylene

("MDPE") or high density polyethylene ("HDPE") made, for example, using the technique disclosed by Anderson *et al.* in U.S. Patent. No. 4,076,698, in that substantially linear ethylene interpolymers are homogeneously branched interpolymers. Further, in accordance with the present invention, the polymer composition does not comprise more than 20 % by weight of heterogeneously branched linear ethylene polymers, as measured by the total weight of the polymer composition.

[0046] Heterogeneously branched ethylene polymers are typically characterized as having molecular weight distributions, M_w/M_n in the range of from about 3.5 to about 4.1 and, as such, are distinct from substantially linear ethylene polymers and homogeneously branched linear ethylene polymers in regards to both compositional short chain branching distribution and molecular weight distribution.

[0047] The substantially linear ethylene polymers useful in this invention have excellent processability, even though they have relatively narrow molecular weight distributions (MWDs). Furthermore, the melt flow ratio (I_{10}/I_2) of the substantially linear ethylene polymers can be varied essentially independently of the polydispersity index (i.e., molecular weight distribution (M_w/M_n)). This is contrasted with conventional heterogeneously branched linear polyethylene resins which have rheological properties such that as the polydispersity index increases, the I_{10}/I_2 value also increases. The rheological properties of substantially linear ethylene polymers also differ from homogeneously branched linear ethylene polymers which have relatively low, essentially fixed I_{10}/I_2 ratios.

[0048] HBEPs and SLEPs also differ significantly from the class known as free-radical initiated highly branched high pressure low density ethylene homopolymer and ethylene interpolymers such as, for example, ethylene-acrylic acid (EAA) copolymers and ethylene-vinyl acetate (EVA) copolymers, in that substantially linear ethylene polymers do not have equivalent degrees of long chain branching and are made using single site catalyst systems rather than free-radical peroxide catalyst systems. In accordance with the present invention, the polymer composition does not comprise more than 20 % by weight of free-radical initiated highly branched high pressure low density ethylene homopolymer and ethylene interpolymers, as measured by the total weight of the polymer composition, exclusive of any adhesive polymer that contains such homopolymers and interpolymers (as discussed in more detail below).

[0049] In some aspects of the present invention, certain component parts of the disclosed carpets are characterized as including woven materials or woven textile. It should be understood that in some aspects woven textiles have the appearance of two-sets of parallel threads or yarns interlaced at generally right angles to each other in the plane of the fabric. "Warp" yarns or threads lie along the length of the fabric and "weft" yarns lie in the transverse direction, *i.e.* across the width of the fabric. The type of yarns used to produce a woven textile can include, without limitation, monofilament, multifilament, a combination of monofilament and multifilament, spun yarns, tape or slit film yarns, or a combination of tape and spun yarns. In some aspects of the invention, the term "tape-spun" yarn refers to yarn having a slit film yarn in the warp direction and spun (relatively short staple length) yarn in the weft direction. In other aspects of the invention, the term "tape-tape" yarn refers to yarn having a slit film yarn both in the warp and the weft directions.

[0050] As described herein, the term "semipermeable" refers to materials that are permeable with respect to certain identified fluids and impermeable to others. For example, a material that is semipermeable to gases will allow the identified gases to permeate through the material over time but will generally not allow non-gaseous fluids to permeate, such as liquids.

[0051] As described herein, the term "impermeable" refers to materials that do not allow the identified substances to pass through it. For example, a liquid impermeable material will not allow liquids to pass through.

[0052] As described herein, in some aspects to determine the efficiency of fluid barriers, the British Spill Test is used. The British Spill Test measures the penetration of a dyed water solution through the carpet product over a 24-hour period. A specified liquid amount, for example, 100 ml of liquid, is poured from a height of one meter through a funnel onto the carpet face, where it is contained in a concentrated area for 24 hours. The carpet is then evaluated for liquid penetration through the product. In some instances the dyed water solution utilized in the test includes but is not limited to Acid Red 40.

[0053] While aspects of the present invention can be described and claimed in a particular statutory class, such as the system statutory class, this is for convenience only and one of skill in the art will understand that each aspect of the present invention can be described and claimed in any statutory class. Unless otherwise expressly stated, it is in no way intended that any method or aspect set forth herein be construed as requiring that its steps be performed in a specific order. Accordingly, where a method claim does not specifically state in the claims or descriptions that the steps are to be limited to a specific order, it is no way intended that an order be inferred, in any respect. This holds for any possible non-express basis for interpretation, including matters of logic with respect to arrangement of steps or operational flow, plain meaning derived from grammatical organization or punctuation, or the number or type of aspects described in the specification.

A. CARPETS AND CARPET STRUCTURES

[0054] As summarized above, aspects of the invention described herein provide a carpet or a carpet product generally comprising: (a) a greige good comprising: i) a primary backing component having a face surface and a back surface; and ii) a plurality of fibers attached to the primary backing component and extending from the face surface of the primary backing component; (b) an adhesive composition applied to the back surface of the primary backing component; (c) a secondary backing having a first surface and a second surface, wherein the first surface of the secondary backing is adhered to the back surface of the primary backing component by the adhesive composition; and (d) a polymer film disposed or on the second surface of the secondary backing, wherein a first portion of the polymer film is adhered to the primary backing component and a second portion of the polymer film is adhered to the second surface of the secondary backing.

[0055] As noted, the greige good comprises a primary backing component having a face surface and a back surface; and a plurality of fibers attached to the primary backing component and extending from the face surface of the primary backing component. To this end, the greige good and thus the resulting finished carpet or carpet product can be any carpet constructed with a primary backing component and includes tufted carpet and non-tufted carpet such as needle punched carpet. To form a tufted carpet, yarn is tufted through the primary backing component such that the longer length of each stitch extends through the face surface of the primary backing component and a portion of the yarn is exposed on the back surface of the primary backing.

[0056] The plurality of fibers can be present in yarn. In other aspects, the plurality of fibers can be present as separate fibers. In further aspects, the plurality of fibers form tufts, such as for example when tufted yarns are present. In still further aspects, a portion of the plurality of the fibers are exposed at the back surface of the primary backing component. In yet other aspects, a portion of the plurality of the fibers are exposed at the back surface of the primary backing component in a form of back stitches.

[0057] The plurality of fibers can comprise a polyamide, a polyolefin, or a polyester. The term “polyamide,” as utilized herein, is defined to be any long-chain polymer in which the linking functional groups are amide (-CO-NH-) linkages. The term polyamide is further defined to include copolymers, terpolymers and the like as well as homopolymers and also includes blends of two or more polyamides. In some aspects, the plurality of polyamide fibers comprise one or more of nylon 6, nylon 66, nylon 10, nylon 612, nylon 12, nylon 11, or any combination thereof. In other aspects, the plurality of polyamide fibers comprise nylon 6 or nylon 66. In yet other aspect, the plurality of polyamide fibers are nylon 6. In a yet further aspect, the plurality of polyamide fibers are nylon 66.

[0058] In some aspects, the plurality of fibers comprise a polyester. The term “polyester fiber” as utilized herein, includes a manufactured fiber in which the fiber forming substance is any long-chain synthetic polymer composed of at least 85% by weight of an ester of a substituted aromatic carboxylic acid, including but not restricted to substituted terephthalic units, $p(\text{-R-O-CO- } C_6H_4\text{-CO-O-})_x$ and parasubstituted hydroxy-benzoate units, $p(\text{-R-O-CO-}C_6H_4\text{-O-})_x$. In some aspects, the plurality of the polyester fibers comprise polyethylene terephthalate (PET) homopolymers and copolymers, polybutylene terephthalate (PBT) homopolymers and copolymers, and the like, including those that contain comonomers such as cyclohexanedimethanol, cyclohexanedicarboxylic acid, and the like.

[0059] In still further aspects, the plurality of fibers can comprise polyolefin. As defined herein, the term “polyolefin” includes any class of polymers produced from a simple olefin (also called an alkene with the general formula C_nH_{2n}) as a monomer. In some aspects, the polyolefins which can be used to produce the yarn and fibers include, but are not limited to, polyethylene, polypropylene, both homopolymer and copolymers, poly(l-butene), poly(3-methyl-l-butene), poly(4- methyl- 1-pentene) and the like, as well as combinations or mixtures of two or more of the foregoing. In certain aspects, the plurality of the polyolefin fibers comprise polyethylene or polypropylene. In other aspects, the plurality of the polyolefin fibers comprise polyethylene. In yet other aspects, the plurality of the polyolefin fibers comprise polypropylene.

[0060] In yet a further aspect, the plurality of fibers can comprise natural fibers, acrylics, viscose, rayon, cellulose acetate, linen, silk, cotton, wool, or any combination thereof.

[0061] As will be understood by one of ordinary skill in the art, the plurality of fibers can further comprise any type or form of fiber. For example, and without limitation, the plurality of fibers can comprise staple fibers or bulked continuous filament fibers.

[0062] As noted above and as understood by one of ordinary skill in the art, the greige good further comprises a primary backing component. In some aspects, the greige good comprises a single primary backing layer. Alternatively, the greige good can comprise a plurality of two or more primary backing layers. In those instances where the primary backing component comprises a plurality of primary backing layers, each of the plurality of layers can be superimposed upon the next such that a back surface of a first primary backing is adjacent to or contacting the top surface of a second primary backing, and so on. The resulting composite primary backing component has a face or top surface provided by the face or top surface of the first primary backing layer and a back or bottom face or surface provided by the back or bottom surface of the second or last in the superimposed series of primary backing layers. Still further, in those aspects where a plurality of primary backing layers are employed, the first and the second primary backings can comprise primary backing materials that are the same or that are different. In view of the foregoing, it should be appreciated that subsequent layers of the disclosed carpet constructions, such as for example the adhesive composition or optional precoat layers described below, are applied to the back surface of the primary backing component, irrespective of whether the primary backing component is comprised of a single primary backing layer or a plurality of primary backing layer.

[0063] The primary backing component comprises a polyolefin, a polyester, a polyamide, or a combination thereof. The primary backing component can be a woven or non-woven primary backing. In certain aspects, the primary backing component can comprise non-woven webs, or spunbonded materials. In some aspects, the primary backing component can comprise a combination of woven and non-woven materials. In some aspects, the primary backing component comprises a polyolefin polymer. In other aspects, the polyolefin polymer comprises polypropylene. In yet other aspects, the primary backing component is a slit film polypropylene sheet such as that sold by PROPEX or Synthetic Industries. In yet further aspects, the primary backing component can comprise polyester. In still further aspects, the primary backing component can comprise polyamide. In yet further aspects, the primary backing component can comprise a combination of polyamide and polyester. To this end, in certain aspects, the polyamide can be a nylon.

[0064] In certain aspects, the primary backing component can be a spun-bond primary backing component. The spun bond primary backing can be produced by depositing extruded, spun filaments onto a collecting belt in a uniform random manner followed by bonding the fibers. The fibers are separated during the web laying process by air jets or electrostatic charges. The collecting surface is usually perforated to prevent the air stream from deflecting and carrying the fibers in an uncontrolled manner. Bonding imparts strength and integrity to the web by applying heated rolls or hot needles to partially melt the polymer and fuse the fibers together. Since molecular orientation increases the melting point, fibers that are not highly drawn can be used as thermal binding fibers. In some aspect, the spun-bond primary backing component can comprise a bi-component filament of a sheath-core type. In some aspects, the polymeric core component can have a higher melting point than the polymeric sheath component. In some aspects, the polymeric core component can comprise polyester, aliphatic polyamides, polyphenylene oxide and/or co-polymers or blends thereof. In yet other aspects, the polyester can comprise polyethylene terephthalate, polybutylene terephthalate, or polyparaphenylene terephthalamide. In yet other aspects, the polymeric core comprises polyethylene terephthalate. In further aspects, the sheath polymer can comprise a polyamide, polyethylene, or polyester. In yet further aspects, the sheath polymer can comprise a nylon. In still further aspects, the sheath-core primary backing component comprises a polyester as a core component and nylon as a sheath component. An exemplary sheath-core primary backing component is commercially available from Bonar.

[0065] Optionally, if desired the greige good can further comprise a precoat layer applied to the back surface of the primary backing prior to application of an adhesive composition. When applied, the precoat layer is disposed between the back surface of the primary backing component and the adhesive composition. Alternatively, if the precoat layer is not present, the adhesive composition can be disposed on the back surface of the primary backing component. The precoat layer can be used to lock the plurality of fibers or tufts in place. In some aspects, the precoat layer can provide additional strength to the tufts (so-called tuft bind strength). In yet other aspects, the precoat layer can be used to substantially prevent adhesive from the adhesive composition from penetrating through any openings that may exist between the plurality of fibers (the tufts) in the direction of the carpet top face.

[0066] In some aspects, the precoat layer comprises an aqueous precoat material. In some exemplary aspects, the aqueous precoat material can, for example, be added as a dispersion or as an emulsion. A precoat emulsion can be made from various polyolefin materials such as, for example and without limitation, ethylene acrylic acid (EAA), ethylene vinyl acetate (EVA), polypropylene or polyethylene (e.g., low density polyethylene (LDPE), linear low density polyethylene (LLDPE) or substantially linear ethylene polymer, or mixtures thereof). In some aspects, the precoat layer can comprise latex. It is further contemplated that the precoat material in the precoat layer can be selected from a group comprising, without limitation, an EVA hotmelt, a vinyl acetate ethylene (VAE) emulsion, carboxylated styrene-butadiene (XSB) latex copolymer, a styrene- butadiene resin (SBR) latex, a BDMMA latex, an acrylic latex, an acrylic copolymer, a styrene copolymer, butadiene acrylate copolymer, a polyolefin hotmelt, polyurethane, polyolefin dispersions and/or emulsions, and any combination thereof.

[0067] In certain aspects, the precoat layer can further comprise one or more flame retardant components. Exemplary flame retardants that can be incorporated into the precoat layer include, without limitation, organo-phosphorous flame retardants, red phosphorous magnesium hydroxide, magnesium dihydroxide, hexabromocyclododecane, bromine containing flame retardants, brominated aromatic flame retardants, melamine cyanurate, melamine polyphosphate, melamine borate, methylol and its derivatives, silicon dioxide, calcium carbonate, resourcinol bis-(diphenyl phosphate), brominated latex base, antimony trioxide, strontium borate, strontium phosphate, monomeric N-alkoxy hindered amine (NOR HAS), triazine and its derivatives, high aspect ratio talc, phosphated esters, organically modified nanoclays and nanotubes, non-organically modified nanoclays and nanotubes, ammonium polyphosphate, polyphosphoric acid, ammonium salt, triaryl phosphates, isopropylated triphenyl phosphate, phosphate esters, magnesium hydroxide, zinc borate, bentonite (alkaline activated nanoclay and nanotubes), organoclays, aluminum trihydrate (ATH), azodicarbonamide, diazenedicarboxamide, azodicarbonic acid diamide (ADC), triaryl phosphates, isopropylated triphenyl phosphate, triazine derivatives, alkaline activated organoclay and aluminum oxide. Any desired amount of flame retardant can be used in the precoat layer and the selection of such amount will depend on a required carpet application. Such amounts can be readily determined through no more than routine experimentation.

[0068] In still a further aspect, the precoat layer can further contain other ingredients. For example, a surfactant can be included. Suitable surfactants can include, for example and without limitation, nonionic, anionic, cationic and fluorosurfactants. In one aspect, the surfactant is present in an amount between about 0.01 and about 5 weight percent based on the total weight of the emulsion or dispersion. In another aspect, the surfactant is anionic. In a further aspect, the surfactant is cationic. In a yet further aspect, the surfactant is nonionic. In a still further aspect, the surfactant is a fluorosurfactant.

[0069] In another aspect, the precoat layer can further comprise a thickener, a defoaming agent, and/or a dispersion enhancer. In this aspect, the thickener helps to provide a suitable viscosity to the dispersion. For example, the thickener can exemplarily comprise sodium and ammonium salts of polyacrylic acids and best present in an amount between about 0.1 and about 5 weight percent based on the total weight of the dispersion. The defoaming agent can, without limitation, be a non-silicone defoaming agent and is present in an amount between about 0.01 and about 5.0 weight percent based on the total weight of the dispersion. An exemplified dispersion enhancer can be a fumed silica that acts as a compatibilizer for the dispersion. In some aspects, the fumed silica is present at between about 0.1 and about 0.2 weight percent based on the total weight of the dispersion.

[0070] In still another aspect, the precoat layer can comprise one or more fillers. Exemplary and non-limiting fillers that can be incorporated into the precoat layer can include calcium carbonate, fly-ash, recycled calcium carbonate, aluminum trihydrate, talc, nano-clay, barium sulfate, barite, barite glass fiber, glass powder, glass cullet, metal powder, alumina, hydrated alumina, clay, magnesium carbonate, calcium sulfate, silica, glass, fumed silica, carbon black, graphite, cement dust, feldspar, nepheline, magnesium oxide, zinc oxide, aluminum silicate, calcium silicate, titanium dioxide, titanates, glass microspheres, chalk, calcium oxide, and any combination thereof. In some aspects, the filler can comprise both calcium carbonate and alumina trihydrate. Calcium carbonate and alumina trihydrate can be present in any relative ratio suitable for a specific carpet application, for example and without limitation, calcium carbonate and alumina trihydrate can be present in a ratio of about 100:1 parts, about 100:2 parts, about 100:3 parts, about 100:4 parts, about 100:5 parts, about 100:6

parts, about 100:7 parts, about 100:8 parts, about 100:9 parts, or about 100:10 parts of calcium carbonate to alumina trihydrate.

[0071] The disclosed carpets and carpet products further comprise an adhesive layer comprised of an adhesive composition applied to the back surface of the primary backing component. As noted above, the back surface of the primary backing component in some aspects can have a precoat layer applied thereto such that the adhesive composition is applied subsequent to the application of the precoat layer. In other aspects where a precoat layer is not present, the adhesive composition can be applied directly to the back surface of the primary backing component.

[0072] The adhesive composition comprises a polymeric adhesive composition. In some aspects, the adhesive composition comprises substantially linear ethylene polymers and homogeneously branched linear ethylene polymers (i.e., homogeneously branched ethylene polymers). Homogeneously branched ethylene polymers (including substantially linear ethylene polymers in particular) have low solidification temperatures, good adhesion to polypropylene, and low modulus relative to conventional ethylene polymers such as low density polyethylene (LDPE), heterogeneously branched linear low density polyethylene (LLDPE), high density polyethylene (HDPE), and heterogeneously branched ultra-low density polyethylene (ULDPE).

[0073] In certain aspects, when the adhesive composition is used for tufted carpets, the tuft bind strength and abrasion resistance of the carpet is increased by encapsulation of the yarn by the substantially linear ethylene polymers and homogeneously branched linear ethylene polymers. In some aspects, a tuft bind (or tuft lock) strength of 3 pounds (1.4 kg) or more, 3.25 pounds (1.5 kg) or more, 5 pounds (2.3 kg) or more, 6 pounds (2.7 kg) or more and 7.5 pounds (3.4 kg) or more is achieved. The tuft bind strength can be also be increased by increasing the molecular weight of the polymer. However, a higher polymer molecular weight selected for improved tuft bind strength is contra to the requirement of a lower polymer molecular weight which is generally needed for good extrusion coatability. Also, higher polymer densities are desirable for improved chemical and barrier resistance, yet higher densities invariably yield stiffer carpets. As such, polymer properties can be chosen such that a balance is maintained between extrusion coatability and abrasion resistance as well as between chemical resistance and carpet flexibility.

[0074] In some aspects, when properly selected substantially linear ethylene polymers or homogeneously branched linear ethylene polymers are used as the adhesive composition, the low flexural modulus of these polymers offers advantages in ease of carpet installation and general carpet handling. Substantially linear ethylene polymers, in particular, when employed as an adhesive composition show enhanced mechanical adhesion to polypropylene which improves the consolidation and delamination resistance of the various carpet layers and components, i.e., polypropylene fibers, fiber bundles, the primary backing component, the adhesive backing material and the secondary backing material when optionally applied. In some aspects, good abrasion resistance is especially important in commercial carpet cleaning operations as good abrasion resistance generally improves carpet durability.

[0075] In certain aspects, the adhesive composition comprising a substantially linear ethylene polymer or homogeneously branched linear ethylene polymer can provide a substantial fluid and particle barrier which enhances the hygienic properties of carpet.

[0076] In some further aspects, use of the adhesive composition comprising a substantially linear ethylene polymer or homogeneously branched linear ethylene polymer can allow totally recyclable carpet products particularly where the carpet comprises polypropylene fibers.

[0077] The adhesive composition can comprise a homogeneously branched ethylene polymer. The homogeneously branched ethylene polymer can have a single melting peak between −30° C and 150° C, as determined using differential scanning calorimetry. In some aspects, the homogeneously branched ethylene polymer used in an adhesive composition in this invention, is a substantially linear ethylene polymer characterized as having (a) a melt flow ratio, $I_{10}/I_2 > 5.63$; (b) a molecular weight distribution, M_w/M_n, as determined by gel permeation chromatography and defined by the equation: $(M_w/M_n) < (I_{10}/I_2) - 4.63$; (c) a gas extrusion rheology such that the critical shear rate at onset of surface melt fracture for the substantially linear ethylene polymer is at least 50 percent greater than the critical shear rate at the onset of surface melt fracture for a linear ethylene polymer, wherein the linear ethylene polymer has a homogeneously branched short chain branching distribution and no long chain branching, and wherein the substantially linear ethylene polymer and the linear ethylene polymer are simultaneously ethylene homopolymers or interpolymers of ethylene and at least one C_3-C_{20} a-olefin and have the same I_2 and M_W/M_n and wherein the respective critical shear rates of the substantially linear ethylene polymer and the linear ethylene polymer are measured at the same melt temperature using a gas extrusion rheometer; and (d) a single differential scanning calorimetry, DSC, melting peak between −30° and 150° C.

[0078] Determination of the critical shear rate in regards to melt fracture as well as other rheology properties such as "rheological processing index" (PI), is performed using a gas extrusion rheometer (GER). The gas extrusion rheometer is described by M. Shida, R. N. Shroff and L. V. Cancio in *Polymer Engineering Science,* Vol. 17, No. 11, p. 770 (1977), and in "Rheometers for Molten Plastics" by John Dealy, published by VanNostrand Reinhold Co. (1982) on pp. 97-99, the disclosures of both of which are incorporated herein by reference. GER experiments are performed at a temperature of 190° C., at nitrogen pressures between about 250 and about 5500 psig (about 1.7 and about 37.4 MPa) using a 0.0754 mm diameter, 20:1 L/D die with an entrance angle of about 180°. For the substantially linear ethylene polymers used herein, the PI is the apparent viscosity (in kpoise) of a material measured by GER at an apparent shear stress of 2.15×10^6 dyne/cm^2 (2.19×10^4 kg/m^2). In certain aspects, the adhesive composition comprises the substantially linear ethylene polymer having a PI in the range of 0.01 kpoise to 50 kpoise, 15 kpoise or less. The substantially linear ethylene polymers used herein also have a PI less than or equal to 70 percent of the PI of a linear ethylene polymer (either a Ziegler polymerized polymer or a homogeneously branched linear polymer as described by Elston in U.S. Pat. No. 3,645,992) having an I_2 and M_w/M_n, each within ten percent of the substantially linear ethylene polymer.

[0079] In some aspects, the homogeneously branched ethylene polymers used in the present invention can be characterized by a single DSC melting peak. The single melting peak is determined using a differential scanning calorimeter standardized with indium and deionized water. The method involves 5-7 mg sample sizes, a "first heat" to about 140° C which is held for 4 minutes, a cool down at 10°/min to −30° C which is held for 3 minutes, and heat up at 10° C/min to 150° C for the "second heat". The single melting peak is taken from the "second heat" heat flow vs. temperature curve. Total heat of fusion of the polymer is calculated from the area under the curve.

[0080] In a further aspect, for polymers having a density of about 0.875 g/cc to about 0.910 g/cc, the single melting peak may show, depending on equipment sensitivity, a "shoulder" or a "hump" on the low melting side that constitutes less than about 12 percent, typically, less than about 9 percent, and more typically less than about 6 percent of the total heat of fusion of the polymer. Such an artifact is observable for other homogeneously branched polymers such as Exact™ resins and is discerned on the basis of the slope of the single melting peak varying monotonically through the melting region of the artifact. Such an artifact occurs within 34° C, typically within 27 °C, and more typically within 20 °C of the melting point of the single melting peak. The heat of fusion attributable to an artifact can be separately determined by specific integration of its associated area under the heat flow vs. temperature curve.

[0081] In certain aspects, the molecular weight distribution (M_w/M_n) for the substantially linear ethylene polymers and homogeneous linear ethylene polymers used in the present invention is generally from about 1.8 to about 2.8. Substantially linear ethylene polymers are known to have excellent processability, despite having a relatively narrow molecular weight distribution. Unlike homogeneously and heterogeneously branched linear ethylene polymers, the melt flow ratio (I_{10}/I_2) of substantially linear ethylene polymers can be varied essentially independently of their molecular weight distribution, M_w/M_n.

[0082] In some aspects, the adhesive composition comprising homogeneously branched ethylene polymers includes interpolymers of ethylene and at least one α-olefin prepared by a solution, gas phase, or slurry polymerization process, or combinations thereof. In some aspects the α-olefins are represented by the following formula: $CH_2{=}CHR$ where R is a hydrocarbyl radical. Further, R may be a hydro-carbyl radical having from one to twenty carbon atoms and as such the formula includes C_3-C_{20} α-olefins. In other aspects, α-olefins for use as comonomers include propylene, 1-butene, 1-isobutylene, 1-pentene, 1-hexene, 4-methyl-1-pentene, 1-heptene and 1-octene, as well as other comonomer types such as styrene, halo- or alkyl-substituted styrenes, tetrafluoro-ethylene, vinyl benzocyclobutene, 1,4-hexadiene, 1,7-octadiene, and cycloalkenes, e.g., cyclopentene, cyclo-hexene and cyclooctene. In certain aspects, the comonomer will be 1-butene, 1-pentene, 4-methyl-1-pentene, 1-hexene, 1-heptene, 1-octene, or mixtures thereof, as adhesive backing materials comprised of higher α-olefins will have especially improved toughness. In yet other aspects, the comonomer will be 1-octene and the ethylene polymer will be prepared in a solution process.

[0083] In certain aspects, the density of the substantially linear ethylene polymer or homogeneously branched linear ethylene polymer, as measured in accordance with ASTM D-792, does not exceed about 0.92 g/cc, and is generally in the range from about 0.85 g/cc to about 0.92 g/cc, from about 0.86 g/cc to about 0.91 g/cc, and from about 0.86 g/cc to about 0.90 g/cc.

[0084] In yet further aspects, the molecular weight of the homogeneously branched linear ethylene polymer or substantially linear ethylene polymer can be characterized using a melt index measurement according to ASTM D-1238, Condition 190° C/2.16 kg (formerly known as "Condition (E)" and also known as I_2). Melt index is inversely proportional to the molecular weight of the polymer. Thus, the higher the molecular weight, the lower the melt index, although the relationship is not linear. The melt index for the homogeneously branched linear ethylene polymer or substantially linear ethylene polymer is generally from about 1 grams/10 minutes (g/10 min) to about 500 g/10 min, about 2 g/10 min to about 300 g/10 min, from about 5 g/10 min to about 100 g/10 min, from about 10 g/10 min to about 50 g/10 min, and about 25 to about 35 g/10 min.

[0085] In some other aspects, an additional measurement can be useful in characterizing the molecular weight of the homogeneous linear ethylene polymer or the substantially linear ethylene polymer and can be performed using a melt index measurement according to ASTM D-1238, Condition 190° C/10 kg (formerly known as "Condition (N)" and also known as I_{10}). The ratio of the I_{10} and the I_2 melt index terms is the melt flow ratio and is designated as I_{10}/I_2. For the substantially linear ethylene polymer, the I_{10}/I_2 ratio indicates the degree of long chain branching, i.e., the higher the I_{10}/I_2 ratio, the more long chain branching in the polymer. The I_{10}/I_2 ratio of the substantially linear ethylene polymer is at least about 6.5, at least about 7, or at least about 8. The I_{10}/I_2 ratio of the homogeneously branched linear ethylene polymer is generally less than about 6.3.

[0086] In some aspects, the ethylene polymers can have a relatively low modulus. That is, the ethylene polymer is characterized as having a 2% secant modulus less than about 24,000 psi (163.3 MPa), less than about 19,000 psi (129.3 MPa), and less than about 14,000 psi (95.2 MPa), as measured in accordance with ASTM D790.

[0087] In certain aspects, the ethylene polymers described herein are substantially amorphous or totally amorphous. That is, the ethylene polymer is characterized as having a percent crystallinity less than about 40 percent, less than about 30 percent, more less than about 20, and less than about 10 percent, as measured by differential scanning calorimetry using the equation:

percent crystallinity % = $(H_f/292)x100$, where H_f is the heat of fusion in Joules/gram.

[0088] In other aspects, the homogeneously branched ethylene polymer (HBEP) can be used alone or can be blended or mixed with one or more synthetic or natural polymeric material. In some aspects, the polymers for blending or mixing with homogeneously branched ethylene polymers used in the present invention include, but are not limited to, another homogeneously branched ethylene polymer, low density polyethylene, heterogeneously branched LLDPE, heterogeneously branched ULDPE, medium density polyethylene, high density polyethylene, grafted polyethylene (e.g. a maleic anhydride extrusion grafted heterogeneously branched linear low polyethylene or a maleic anhydride extrusion grafted homogeneously branched ultra-low density polyethylene), ethylene acrylic acid copolymer, ethylene vinyl acetate copolymer, ethylene ethyl acrylate copolymer, polystyrene, polypropylene, polyester, polyurethane, polybutylene, polyamide, polycarbonate, rubbers, ethylene propylene polymers, ethylene styrene polymers, styrene block copolymers, and vulcanates.

[0089] In further aspects, the adhesive composition can comprise a blend of at least two polyethylenes, wherein the polyethylene can comprise a homogeneously branched ethylene polymer (HBEP) or a substantially linear ethylene polymer (SLEP), or mixtures thereof. In other aspects, the adhesive composition can comprise a blend of at least three or four, or more polyethylenes, wherein the polyethylenes comprise a homogeneously branched ethylene polymer (HBEP) or a substantially linear ethylene polymer (SLEP), or mixtures thereof. Still further, adhesive composition can comprise a polyethylene comprising at least about 80% by weight of at least one (or two or more) HBEP or SLEP as measured by weight of the polyethylene, including exemplary values of about 85, 90, 95, 97, 98, or about 99% by weight of the polyethylene, where any value can comprise an upper or a lower endpoint, as appropriate.

[0090] In aspects where a blend of at least two (or three or more) polyethylenes is used, the amount of each polyethylene present in the blend can be individually varied in the amounts of, for example, from at least about 0.1, 1, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 97 or about 98% by weight of the total blend, where any value can be used for the individual components and the combined relative amount of polyethylenes totals 100 % by weight. Similarly the amount of each polyethylene present in the blend can be individually varied in the amounts of, for example, up to an upper limit amount of to about 0.1, 1, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 97 or about 98% by weight of the total blend. Still further, each individual polyethylene can be present in any range of amounts derived from the above lower and upper limit amounts.

[0091] The density of the polyethylene components in the blend can be from about 0.860, 0.870, 0.880, 0.885, 0.890, 0.895, 0.900, 0.905, or about 0.910 g/cc, where any value can comprise an upper or a lower endpoint, as appropriate.

[0092] The actual blending or mixing of various polymers may be conveniently accomplished by any technique known in the art including, but not limited to, melt extrusion compounding, dry blending, roll milling, melt mixing such as in a Banbury mixer and multiple reactor polymerization. In some aspects, the blends or mixtures include a homogeneously branched ethylene polymer and a heterogeneously branched ethylene α-olefin interpolymer, wherein the α-olefin is a C_3-C_8 α-olefin prepared using two reactors operated in parallel or in series with different catalyst systems employed in each reactor. Multiple reactor polymerizations are described, for example, in U.S Patent No. 5,677,383, the disclosure of which is incorporated herein by reference. In some aspects, multiple reactor polymerizations comprise non-adiabatic solution loop reactors as described, for example, in international Patent Cooperation Treaty (PCT) application number PCT/US97/05420 and U.S. Patent No. 5,977,251, the disclosures of both of which are incorporated herein by reference.

[0093] In another aspect, the adhesive composition can comprise a modified homogeneously branched ethylene polymer. In particular, in certain aspects of the invention the at least one homogeneously branched ethylene polymer that can be present within the adhesive composition can be modified by the addition of at least one adhesive polymeric additive. Suitable adhesive polymeric additives include, for example and without limitation, polymer products comprised of (1) one or more ethylenically unsaturated carboxylic acids, anhydrides, alkyl esters and half esters, e.g., acrylic acid, methacrylic acid, maleic acid, maleic anhydride, itaconic acid, fumaric acid, crotonic acid and citraconic acid, citraconic anhydride, succinnic acid, succinnic anhydride, methyl hydrogen maleate, and ethyl hydrogen maleate; esters of ethylenically unsaturated carboxylic acids, e.g., ethyl acrylate, methyl methacrylate, ethyl methacrylate, methyl acrylate, isobutyl acrylate, and methyl fumarate; unsaturated esters of carboxylic acids, e.g., vinyl acetate, vinyl propionate, and vinyl benzoate; and ethylenically unsaturated amides and nitriles e.g., acrylamide, acrylonitrile, methacrylonitrile and fumaronitrile; and (2) one or more ethylenically unsaturated hydrocarbon monomers such as aliphatic α-olefin monomers, e.g., ethylene, propylene, butene-1 and isobutene; conjugated dienes, e.g., butadiene and isoprene; and monovinylidene aromatic carbocyclic monomers, e.g., styrene, α-methylstyrene, toluene, and t-butylstyrene.

[0094] A modified homogeneously branched ethylene polymer for use in the adhesive composition can be conveniently prepared by known techniques such as, for example, by interpolymerization or by a polymerization procedure followed by a chemical or extrusion grafting procedure. Suitable grafting techniques are described in U.S. Pat. Nos. 4,762,890; 4,927,888; 4,230,830; 3,873,643; and 3,882,194, the disclosures of all of which are incorporated herein by reference.

[0095] In some aspects, the adhesive polymeric additives for use in the present invention can include maleic anhydride grafts wherein maleic anhydride is grafted onto an ethylene polymer at a concentration of about 0.1 to about 5.0 weight percent, about 0.5 to about 1.5 weight percent. The presence of ethylene polymer/maleic anhydride grafts as adhesive polymeric additives in the present invention can improve the performance and operating window of extrusion coated homogeneously branched ethylene polymers as the adhesive composition, especially when used in connection with polar polymers such as for example, but is not limited to, nylon and polyester faced carpets. The improvement pertained to substantially higher comparative abrasion resistance and tuft bind strength. In an exemplary aspect, a composition for forming a maleic anhydride graft is the Amplify® GR 204 available from Dow Chemicals.

[0096] In further aspects, the ethylene polymers for use as the grafted host polymer include low density polyethylene (LDPE), high density polyethylene (HDPE), heterogeneously branched linear low density polyethylene (LLDPE), homogeneously branched linear ethylene polymers and substantially linear ethylene polymers. In some aspects, the host ethylene polymers have a polymer density greater than or equal to about 0.86 g/cc, 0.87 g/cc, 0.88 g/cc, 0.89 g/cc, 0.90 g/cc, 0.91 g/cc, 0.92 g/cc, 0.93 g/cc, or greater than or equal to about 0.94 g/cc. In yet other aspects, the substantially linear ethylene polymers and high density polyethylene are utilized as host ethylene polymers.

[0097] In some aspects, it is contemplated that the adhesive composition can be applied as an extruded layer or it can applied by any other technique known in the art onto the back surface of the primary backing component. Still further, it should be understood that the polymeric adhesive composition can be used neat, or can have one or more additives included. In this aspect, the adhesive composition of this invention may optionally include exemplary additives such as foaming agents, pH controllers, flame retardants, fillers, tackifiers, wetting agents, dispersing agents, anti-microbial agents, lubricants, dyes, anti-oxidants, and the like, which are well known to those skilled in the art, without loss of the characteristic properties.

[0098] In one aspect, the adhesive composition further comprises one or more flame retardants sufficient to ensure the carpet structure satisfies the requirements of the radiant flux floor covering test according to the ASTM-E648 testing procedures. In particular, according to certain aspects, the carpet structures of the present invention exhibit a Class 1 critical radiant flux of greater than 0.45 watts per cm^2 as measured according to ASTM-E648. According to other aspects of the invention, the carpet structures described herein can exhibit a Class 2 critical radiant flux in the range of from 0.22 to 0.44 watts per cm^2 as measured according to ASTM-E648. In still further aspects, the carpet structures of the present invention can exhibit an unclassifiable critical radiant flux of less than 0.22 watts per cm^2 as measured according to ASTM-E648.

[0099] Exemplary flame retardants that can be incorporated into the adhesive compositions of the present invention include, without limitation, organo-phosphorous flame retardants, red phosphorous magnesium hydroxide, magnesium dihydroxide, hexabromocyclododecane, bromine containing flame retardants, brominated aromatic flame retardants, melamine cyanurate, melamine polyphosphate, melamine borate, methylol and its derivatives, silicon dioxide, calcium carbonate, resourcinol bis-(diphenyl phosphate), brominated latex base, antimony trioxide, strontium borate, strontium phosphate, monomeric N-alkoxy hindered amine (NOR HAS), triazine and its derivatives, high aspect ratio talc, phosphated esters, organically modified nanoclays and nanotubes, non-organically modified nanoclays and nanotubes, ammonium polyphosphate, polyphosphoric acid, ammonium salt, triaryl phosphates, isopropylated triphenyl phosphate, phosphate esters, magnesium hydroxide, zinc borate, bentonite (alkaline activated nanoclay and nanotubes), organoclays, aluminum trihydrate (ATH), azodicarbonamide, diazenedicarboxamide, azodicarbonic acid diamide (ADC), triaryl phosphates, isopropylated triphenyl phosphate, triazine derivatives, alkaline activated organoclay and aluminum oxide. Any desired amount of flame retardant can be used in the adhesive compositions of the instant invention and the selection of such amount will depend, in part, upon the particular flame retardant used and desired carpet applications. Such amounts can be readily determined through no more than routine experimentation.

[00100] Exemplary and non-limiting fillers that can be incorporated into the adhesive composition of the present invention can include calcium carbonate, fly-ash, recycled calcium carbonate, aluminum trihydrate, talc, nano-clay, barium sulfate, barite, barite glass fiber, glass powder, glass cullet, metal powder, alumina, hydrated alumina, clay, magnesium carbonate, calcium sulfate, silica, glass, fumed silica, carbon black, graphite, cement dust, feldspar, nepheline, magnesium oxide, zinc oxide, aluminum silicate, calcium silicate, titanium dioxide, titanates, glass microspheres, chalk, calcium oxide, and any combination thereof. In one aspect, the adhesive composition comprises inorganic filler with high heat content. In some aspects, it is for the filler to exhibit relatively high heat content. Examples of such fillers include, but are not limited to, calcium carbonate, aluminum trihydrate, talc, and barite. The exemplified high heat content fillers allow the extrudate to remain at elevated temperatures longer with the beneficial result of providing enhanced encapsulation and penetration. In this aspect, the high heat content fillers should be ground or precipitated to a size that can be conveniently incorporated in an extrusion coating melt stream. Exemplary non-limiting particle sizes for the inorganic filler material can include particle sizes in the range of from about 1 to about 50 microns. Still further, it should also be understood that the filler component can be present in any desired amount. However, in an exemplary aspect, the filler is present in an amount in the range of from about 10 weight % to about 90 weight %, based upon the total weight of the adhesive composition, including exemplary amounts of about 15 weight %, 20 weight %, 25 weight %, 30 weight %, 35 weight %, 40 weight %, 45 weight %, 50 weight %, 55 weight %, 60 weight %, 65 weight %, 70 weight %, 75 weight %, 80 weight %, and about 85 weight %. Still further, the amount of filler present can be in any range derived from any two of the above stated weight percentages.

[00101] In still another aspect, the adhesive composition can further comprise one or more tackifying additives. The tackifier can for example be tall oil or rosin based or, alternatively, can be an aliphatic or aliphatic aromatic hydrocarbon blend resin. As the tackifier is an optional component, the amount of tackifier can be, when present, in the range of from greater than 0 weight percent up to and even exceeding about 50 weight % of the adhesive composition. For example, in one aspect, the amount of tackifier can be in the range of from about 5 weight % to about 45 weight %. In still another aspect, the amount of tackifier can be in the range of from about 10 weight % to about 20 weight %.

[00102] In some aspects, the adhesive compositions of the current invention can comprise latex adhesive materials. In yet other aspects, the adhesive composition can comprise non-latex adhesive materials. In such aspects, the adhesive materials can include polyurethanes, hot melt adhesives of various compositions, polyvinylchloride and meltable powders.

[00103] In certain aspects, the adhesive composition is present in an amount of about 10 ounces/sq. yard or less, including exemplary values of about 9 ounces/sq. yard, about 8 ounces/sq. yard, about 7 ounces/sq. yard, about 6 ounces/sq. yard, about 5 ounces/sq. yard, about 4 ounces/sq. yard, about 3 ounces/sq. yard, about 2 ounces/sq. yard, and about 1 ounces/sq. yard. In other aspects, the adhesive composition can be present in an amount in any range derived from any two of the above stated values. For example, and without limitation, the adhesive composition can be present in an amount from about 3 ounces/sq. yard to about 8 ounces/sq. yard, or in amount from about 2 ounces/sq. yard to about 7 ounces/sq. yard, or from about 5 ounces/sq. yard to about 10 ounces/sq. yard.

[00104] In yet further aspects, the disclosed adhesive composition when applied to the carpet forms an adhesive layer. In certain aspects, the carpet disclosed herein comprises one adhesive layer. In other aspects, the carpet can comprise two or more adhesive layers. The final number of the adhesive layers can be determined by one of ordinary skill in the art depending on the desired application.

[00105] Following application of the adhesive composition, a secondary backing layer can be applied. The secondary backing has a first surface and a second surface, wherein the first surface of the secondary backing is adhered to the back surface of the primary backing component by the adhesive composition. In one aspect the secondary backing comprises a woven material. In another aspect, the secondary backing comprises a tape-tape yarn type backing, or a tape-spun yarn type backing. In certain aspects, the secondary backing is a tape-tape yarn woven material. In some aspects, the secondary backing comprises a polyolefin. In a yet further aspect, the polyolefin can comprises polypropylene. In certain exemplary aspects, the material for the secondary backing material can be a conventional material, for example and without limitation, a woven polypropylene fabric sold by Propex. Such exemplary secondary backings can also comprise a material that is a leno weave with polypropylene tape running in one direction and polypropylene spun yarn running in the other. In still other aspects, the secondary backing material used with the present invention is a woven polypropylene fabric with monofilaments running in both directions. A suitable example of such a material is manufactured by Shaw Industries, Inc. under the designation Style S8880.

[00106] In further aspects, the secondary backing material can be a material known as a fiber lock weave or "FLW." FLW is a fabric which includes fibers needle punched into it. It is contemplated that an FLW type fabric can also be used as a primary backing component, for example, in a carpet with a relatively low pile height or weight.

[00107] In some aspects, the secondary backing can be a woven needle punched polypropylene fabric such as SoftBac® manufactured by Shaw Industries, Inc. In this exemplary aspect, this material has been enhanced by having about 1.5 ounce/sq. yard of polypropylene fibers or polyethylene terephthalate fibers needle punched onto one side of it and has a total basis weight of about 3.5 ounce/sq. yard. This needle punched fabric can be laminated so as to have the polypropylene fibers embedded within the adhesive backing layer. In still further aspects other materials can be used for the secondary backing, for example, and without limitation, if an integral pad is desired, a polyurethane foam or other cushion material can be laminated to the back side of the carpet. Such backings can be used for broadloom carpet or carpet tiles.

[00108] As disclosed herein, the carpet can further comprise a polymer film disposed on the second surface of the secondary backing. In an exemplary aspect, a first portion of the polymer film can be adhered to the primary backing component and a second portion of the polymer film is adhered to the second surface of the secondary backing. In certain aspects, the polymer film is disposed on the second surface of the secondary backing and is co-laminated with the secondary backing to the primary backing component.

[00109] In some aspects, the polymer film disposed on the second surface of the secondary backing comprises a thermoplastic material. In other aspects, the polymer film comprises polymers and copolymers of polyethylene, polypropylene, polyurethane, polyester, polyvinylchloride, nylon and polyethylene vinyl acetate. In yet other aspects, the polymer film comprises polyethylene, polypropylene, polyurethane, polyester, or polyvinylchloride. In a yet further aspect, the polymer film is polyethylene. In yet further aspects, the polymer film is a combination of polyethylene and polyester. In certain aspects, the polymer film is an extruded film. In yet other aspects, the polymer film is a blown film. In a yet further aspect, the polymer film is a cast film. In a still further aspect, the polymer film is an engineered film. The term "engineered film" as used herein refers to a polymer film comprising either a single uniform polymer or copolymer, or a blend of different polymers and copolymers, wherein the film is formed by various techniques to ensure desirable properties. For example, in some aspects the engineered film can be a reinforced film. In some other aspects, and without limitation, the engineered reinforced film can comprise a plurality of layers of the same or different polymer or copolymer. In other aspects, the engineered film can comprise layers of polyethylene film sandwiched with a layer of polyester. In yet further aspects, the engineered film can comprise layers of polyethylene and polypropylene, or layers of polyethylene and chemically resistant ethylene vinyl alcohol (EVOH) copolymer. Exemplary engineered films suitable for use in the disclosed carpet structures include those commercially available from Raven Industries.

[00110] In some aspects, the polymer film is a fluid barrier. In yet other aspects, the polymer film is a semipermeable material. For example, in certain aspects, the polymer film can be semipermeable to gases but not liquids. In some aspects, the polymer film is semipermeable to all atmospheric gases. In exemplary aspects and without limitation, the polymer film is semipermeable to oxygen, hydrogen, carbon dioxide, carbon oxide, nitrogen, and the like. In yet other aspects, the polymer film can be impermeable to gases. In certain aspects, the polymer film is impermeable, for example, and without limitations, to volatile organic compounds (VOCs), methane, carbon dioxide, carbon oxide, radon, gasoline, benzene and the like. In yet further aspects, the polymer film can be impermeable to the vapors.

[00111] In certain aspects, the polymer film is impermeable to fluids. For example, in some aspects the polymer film is impermeable to aqueous fluids. In still other aspects, the polymer film can be impermeable to non-aqueous fluids. In further aspects, the non-aqueous fluid can be an organic fluid. In further exemplary aspects, the polymer film can be impermeable to water, carbonated and non-carbonate beverages, juices, milk, wine, or other alcoholic beverages and substances, human or pet bodily fluids such as blood or urine, food based fluids, food processing fluids, rain, or snow melt.

[00112] The polymer film can have any desired thickness. For example, the polymer film can have a thickness of less than about 6 mils. In other aspects, the polymer film can have a thickness of about 5.5 mils, about 5 mils, about 4.5 mils, about 4 mils, about 3.5 mils, about 3 mils, about 2.5 mils, about 2 mils, about 1.5 mils, about 1 mil, and about 0.5 mils. In other aspects, the polymer film can have a thickness in any range derived from any two of the above stated values. For example, and without limitation the polymer film can have thickness from about 1 mil to about 5.5 mils, or from about 2 mils to about 4 mils, or from about 1 mil to about 3.5 mils. In other aspects the polymer film can have a thickness of about 6 mils.

[00113] In other aspects, the polymer film can have a thickness of greater than about 6 mils. For example, the polymer film can have a thickness of about 7 mils, about 8 mils, about 9 mils, about 10 mils, about 15 mils, about 20 mils, about 25 mils, about 30 mils, about 35 mils, about 40 mils, about 45 mils, about 50 mils, about 55 mil, about 60 mils, about 65 mils, about 70 mils, about 75 mils, about 80 mils, about 85 mils, about 90 mils, and about 100 mils. In other aspects, the polymer film can have a thickness in any range derived from any two of the above stated values. For example, and without limitation the polymer film can have thickness from about 10 mils to about 40 mils, or from about 30 mils to about 50 mils, or from about 30 mil to about 80 mils.

[00114] **FIG. 1** schematically shows an exemplary aspect of this invention. Specifically, **FIG.1** demonstrates an exemplary carpet structure **100** disclosed herein. A plurality of fibers **102** are attached to or tufted into a primary backing component **104** and extending from a face surface of the primary backing component. A portion of the plurality of fibers is exposed at a back surface of the primary backing component in the form of back stitches **106**. An optional precoat layer **108** is applied to the back surface of the primary backing component and the back stiches. An adhesive composition **110** is further applied to the inventive carpet. A polymer film **114** is disposed on a second surface of the secondary backing **112.** The polymer film **114** and the secondary backing **112** are co-laminated to the primary backing component, such that a first portion of the polymer film is adhered to the primary backing component and a second portion of the polymer film is adhered to the second surface of the secondary backing.

[00115] In a specific exemplary and non-limiting aspect, disclosed herein is a carpet comprising: (a) a greige good comprising: i) a primary backing component having a face surface and a back surface; ii) a plurality of fibers attached to the primary backing component and extending from the face surface of the primary backing component; (b) an adhesive composition applied to the back surface of the primary backing component; (c) a woven tape-tape yarn secondary backing having a first surface and a second surface, wherein the first surface of the secondary backing is adhered to the back surface of the primary backing component by the adhesive composition; and (d) a polymer film disposed on the second surface of the secondary backing. According to aspects, the polymer film can be disposed such that a first portion of the polymer film is adhered to the primary backing component and a second portion of the polymer film is adhered to the second surface of secondary backing.

[00116] It has been found that the disclosed carpets can advantageously be constructed to provide desired levels of fluid barrier protection. In similar fashion to the polymer film properties described above, the disclosed carpets can provide fluid barrier protection from, for example, spilled liquids. In some aspects, the carpet can be semipermeable to select materials. For example, in certain aspects, the carpet can be semipermeable to gases but not liquids. In some aspects, the carpet can be semipermeable to all atmospheric gases. In exemplary aspects and without limitation, the carpet can be semipermeable to oxygen, hydrogen, carbon dioxide, carbon oxide, nitrogen, and the like. In yet other aspects, the carpet can be impermeable to gases. In certain aspects, the carpet is impermeable, for example, and without limitations, to volatile organic compounds (VOCs), methane, carbon dioxide, carbon oxide, radon, gasoline, benzene and the like. In yet further aspects, the carpet can be impermeable to the vapors.

[00117] In further aspects, the carpet can be impermeable to fluids. For example, in some aspects the carpet is impermeable to aqueous fluids. In still other aspects, the carpet can be impermeable to non-aqueous fluids. In further aspects, the non-aqueous fluid can be an organic fluid. In further exemplary aspects, the carpet can be impermeable to water, carbonated and non-carbonate beverages, juices, milk, wine, or other alcoholic beverages and substances, human or pet bodily fluids such as blood or urine, food based fluids, food processing fluids, rain, or snow melt.

[00118] It should be appreciated that according to some aspects, a disclosed carpet that is liquid impermeable but that is permeable to gas and vapors can provide a carpet having good protection against liquid penetration while also providing for good breathability.

[00119] In an exemplary aspect, the fluid barrier protection and properties of the disclosed carpets can be analyzed and exhibited pursuant to the protocols of the British Spill Test. The British Spill Test measures the penetration of a dyed water solution through a carpet product over a 24-hour period. A specified liquid amount, for example, 100 ml of liquid, is poured from a height of one meter through a funnel onto the carpet face, where it is contained in a concentrated area for 24 hours. The carpet is then evaluated for liquid penetration through the product. In some instances the dyed water solution utilized in the test includes but is not limited to Acid Red 40. The disclosed carpets advantageously exhibit a pass rating under the British Spill Test. To this end, according to aspects, the disclosed carpets can provide a complete barrier to fluid penetration over this 24 hour testing period.

[00120] In addition to the pass rating of the British Spill Test, the disclosed carpets also provide enhanced protection against wicking of spilled liquids. This enhanced protection against wicking enables ease of clean up by containing a spilled liquid in a more concentrated area and can prevent the undesired expansion of a spill. To this end, again using the protocol of the British Spill Test where a specified liquid amount, for example, 100 ml of liquid, is poured from a height of one meter through a funnel onto the carpet face, an initial stain area can be quantified through visual inspection of the stain. The area of this stain can then be quantified through visual inspection after a desired period of time. The desired period of time can be any duration, including for example the 24 hours utilized in the British Spill Test. Alternatively, the desired period of time can be greater or less than 24 hours, such as 5 minutes, 15 minutes, 30 minutes, 60 minutes, 1 hour, 5 hours, 10 hours, 12, hour, 18 hours, 30 hours, 36 hours, or even 48 hours.

[00121] According to aspects, the disclosed carpets can exhibit enhanced wicking protection as evidenced by a substantial containment or substantial unchanged area of initial spill as described above. For example, an area of an initial spill pursuant to the British Spill Test can be visually quantified. This can be identified as spill spot or spill area at time zero or T_0. The area of the spill can then be quantified after the expiration of a defined testing period, such as 24 hours. To this end, according to aspects, the disclosed carpets can exhibit a spill spot or spill area after a 24 hour period of time that is substantially contained or substantially unchanged from the initial spill spot area.

[00122] As used herein, a “substantially contained” or “substantially unchanged” spill spot or spill area can include a spill spot area that has not increased in size relative to an initial spill area over a selected testing period, such as for example 24 hours. Alternatively, this can include a spill spot area that has not increased in size relative to an initial spill area by more than about 0.5 %, about 1 %, about 5 %, about 10 %, about 25 %, or about 50 % over a selected testing period, such as for example 24 hours. In further aspects, the disclosed carpets can exhibit wicking protection characterized by spill spot areas that do not increase by more than about 80 %, about 100 %, about 150 %, about 200 %, about 250 %, about 300 %, about 400 %, about 500 %, about 600%, about 700%, about 800%, about 900%, or even about 1000% of an original spill spot area over a selected testing period, such as for example 24 hours. As one of ordinary skill in the art will appreciate, an evaluation of wicking and any potential increase in spill spot size over a testing period can depend on the overall sample size upon which a test fluid is spilled. To that end, it should be appreciated that in some aspects, the above wicking characteristics are exhibited on sample sizes that are at least larger than the maximum spill spot size exhibited by the carpet over a selected testing period. Again, it should also be understood that the desired testing period can be any duration, including for example the 24 hours utilized in the British Spill Test. Alternatively, the desired period of time can be greater or less than 24 hours, such as 5 minutes, 15 minutes, 30 minutes, 60 minutes, 1 hour, 5 hours, 10 hours, 12, hour, 18 hours, 30 hours, 36 hours, or even 48 hours. In still further aspects, the enhanced wicking protection exhibited by the disclosed carpets can be characterized by an initial spill spot or area that does not wick to one or more edges of a testing sample carpet after a selected testing period.

[00123] In some aspects, the disclosed carpets and carpet structures can be provided as broadloom carpet. In yet further aspects, the disclosed carpet and carpet products can be provided as a turf. Still further, it should be understood that, for example, in those aspects provided as turf, the carpet can further comprise one or more additional components selected to achieve desirable properties. For example and without limitation, in some aspects such carpets can comprise additional energy management materials such as energy reflecting and adsorbing materials, thermal insulation materials, and the like.

B. METHODS OF MAKING CARPETS

[00124] In still further aspects, disclosed herein are the methods of making the disclosed carpets. In some aspects, disclosed herein is a method of making a carpet comprising: (a) providing a greige good comprising: i) a primary backing component having a face surface and a back surface; ii) a plurality of fibers attached to the primary backing component and extending from the face surface of the primary backing component; (b) applying an adhesive composition to the back surface of the primary backing component; (c) co-laminating a secondary backing and a polymer film to the back surface of the primary backing component such that i) a first surface of the secondary backing is adhered to the back surface of the primary backing component by the adhesive composition, and at least a portion of the polymer film is adhered to the back surface of the secondary backing. In some aspects, a first portion of the polymer film is adhered to the primary backing component and a second portion of the polymer film is adhered to a second surface of the secondary backing.

[00125] The face of a tufted carpet can generally be made in three ways. First, for loop pile carpet, the yarn loops formed in the tufting process are left intact. Second, for cut pile carpet, the yarn loops are cut, either during tufting or after, to produce a pile of single yarn ends instead of loops. Third, some carpet styles include both loop and cut pile. One variety of this hybrid is referred to as tip-sheared carpet where loops of differing lengths are tufted followed by shearing the carpet at a height so as to produce a mix of uncut, partially cut, and completely cut loops. Alternatively, the tufting machine can be configured so as to cut only some of the loops, thereby leaving a pattern of cut and uncut loops. Whether loop, cut, or a hybrid, the yarn on the back surface of the primary backing component comprises tight, unextended loops. The combination of tufted yarn and a primary backing component without the application of an adhesive backing material or secondary backing material is referred to in the carpet industry as raw tufted carpet or greige goods. Greige goods become finished tufted carpet with the application of an adhesive backing material and secondary backing material if present to the back surface of the primary backing component. In the aspects of the current invention, the greige goods become finished tufted carpet with the application of an adhesive backing material, the secondary backing material and the polymer film. In certain aspects of the invention, the polymer film is a fluid barrier. Finished tufted carpet can be prepared as broad-loomed carpet in rolls typically 6 or 12 feet wide.

[00126] Any conventional tufting or needle-punching apparatus and/or stitch patterns can be used to make the carpets of the present invention. Likewise, it does not matter whether tufted yarn loops are left uncut to produce a loop pile; cut to make cut pile; or cut, partially cut and uncut to make a face texture known as tip sheared. After the yarn is tufted or needle-punched into the primary backing component, the greige good can be conventionally rolled up with the back surface of the primary backing component facing outward and held until it is transferred to the backing line.

[00127] In one exemplary aspect, the greige good can be scoured or washed before it has an adhesive composition applied thereon to remove or displace all or substantially all of the processing materials, such as for example oily or waxy chemicals, known as spin-finish chemicals, that remain on the yarn from the yarn manufacturing processes. It is also contemplated that the use of polyolefin waxes (rather than conventional organic and mineral oils) as processing materials would allow improved adhesive composition performance in itself or at least minimize the use of scouring or washing methodologies.

[00128] The disclosed adhesive composition can be applied to the back surface of the primary backing component to affix the yarn to the primary backing component. In one aspect, the adhesive backing substantially encapsulates a portion of the back stitching of the yarn, penetrates the yarn, and binds individual carpet fibers. Properly applied adhesive compositions do not substantially pass through the primary backing component.

[00129] In some aspects the greige good further comprises a precoat layer disposed between the back surface of the primary backing component and the adhesive composition. The precoat can be applied to the carpet in various ways. For example, the dispersion can be applied directly, such as with a roll over roller applicator, or a doctor blade. Alternatively, the precoat can be applied indirectly, such as with a pan applicator. It is contemplated that the amount of precoat applied and the concentration of the particles in the precoat can be varied depending on the desired processing and product parameters. In one exemplary aspect, the amount of dispersion applied and the concentration of the particles are selected so as to apply between about 4 and about 12 ounces per square yard (OSY) of carpet. Accordingly, it should be understood that desired application weight of the precoat will depend, at least in part, upon the presence and amount of inorganic fillers and/or flame retardants in the precoat. In an exemplary aspect, a latex precoat is the LXC 807 NA from Trinseo S.A..

[00130] In further aspects, after application of the precoat, heat can be applied to the back surface of the primary backing component so as to dry, melt, and/or cure the emulsion. As a result, the loops of yarn can be at least partially fixed to the primary backing component. In some aspects, the heat is applied by passing the product through an oven.

[00131] After treatment with the optional precoat layer additional layers of materials can be applied thereto. The additional layers can be applied by various methods including but not limited to involving the use of an extruded sheet of an adhesive composition as described above, onto which a secondary backing can also be laminated. In some aspects, a molten adhesive composition is extruded through a die so as to make a sheet which is as wide as the carpet. The molten, extruded sheet is applied to the back surface of the primary carpet backing or a precoat layer if present. Since the sheet is molten, the sheet will conform to the shape of the loops of yarn and further serve to encapsulate and fix the loops in the primary backing component. In aspects where a precoat has been applied to the back surface of the primary backing component, it will be understood that the precoat is disposed between the adhesive backing composition and the back surface of the primary backing component. Alternatively, according to aspects where the optional precoat layer is not applied, the adhesive composition of the present invention is applied directly on the back surface of the primary backing component and can, itself, serve to fix the loops in the primary backing component.

[00132] In aspects where extrusion techniques are used, exemplary extrusion coating configurations can include, without limitation, a monolayer T-type die, single-lip die coextrusion coating, dual-lip die coextrusion coating, a coat hanger die, and multiple stage extrusion coating. In some aspects, the extrusion coating equipment is configured to apply a total coating weight of from about 1 to about 60 ounces/yd^2 (OSY), including exemplary amounts of about 2, 3, 4, 5, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50 and about 55 ounces/yd^2 (OSY), and any range of coating weights derived from these values. To that end, it should be understood that the desired coating weight of the extrusion coated layers will depend, at least in part, upon the amount of any flame retardants or mineral fillers in the extrudate.

[00133] The extrusion coating melt temperature principally depends on the particular composition of the adhesive composition being extruded. When using the adhesive composition described above, comprising the disclosed substantially linear polyethylene, the extrusion coating melt temperature can be greater than about 350° F and, in some aspects, in the range of from 350° F to 650° F. In another aspect, the melt temperature can be in the range of from 375° F to 600° F. Alternatively, the melt temperature can be in the range of from 400° F to 550° F. Still further, in aspects of the invention the melt temperature can be in the range of from 425° F to 500° F.

[00134] As described herein, the disclosed carpet further comprises a secondary backing having a first surface and a second surface, wherein the first surface of the secondary backing is facing the back surface of the primary backing component. In further aspects, the carpet comprises a polymer film disposed on the second surface of the secondary backing. In some aspects, the polymer film is provided simultaneously with the secondary backing and then co-laminated to the primary backing component. In other aspects, the polymer film is separately disposed on the second surface of the secondary backing prior to laminating the secondary backing to the greige goods with the adhesive material. In these exemplary aspects, the polymer film disposed on the second surface of the secondary backing is further co-laminated in such way that the first surface of the secondary backing is adhered to the back surface of the primary backing component by the adhesive composition, and the polymer film disposed on the second surface of the secondary backing and wherein a first portion of the polymer film is adhered to the primary backing component and a second portion of the polymer film is adhered to the second surface of the secondary backing.

[00135] The polymer film can be prepared by any techniques known in the art. In some aspects, the polymer film can be extruded. In yet other aspects, the polymer film can be blown. In yet further aspects, the polymer film can be cast. In still further aspects, the polymer film can be engineered to provide desirable characteristics.

[00136] **FIG. 2** shows exemplary line **200** for making a carpet **100** shown in **FIG. 1**. As shown in **FIG. 2**, a carpet greige goods **204** made by attaching a plurality of fibers to the primary backing component and extending from the face surface of the primary backing component are provided by roll **202**, wherein the back surface of the primary backing component **206** is facing up. In some aspects, the carpet greige goods **204** are provided with a precoat layer disposed on the primary backing component. In this exemplary line, the disclosed secondary backing **212** and the polymer film **216** are directed from roll **210,** wherein the polymer film is disposed on a second surface **214** of the secondary backing. It is understood to one of ordinary skill in the art that the secondary backing and the polymer film can be provided together or separately, and wherein the secondary backing and the polymer film can be provided by any technique known in the art. The disclosed adhesive composition **208** is applied to the back surface of the primary backing component, or a precoat layer, if present, and to a first surface of the secondary backing. The greige goods with or without the precoat layer, the adhesive composition, the secondary backing and the polymer film are passed between a set of nip rolls (or pinch rolls) **218** to co-laminate the secondary backing and a polymer film to the back surface of the primary backing component. Co-laminating of the secondary backing and the polymer film to the back surface of the primary backing component is performed such as that the first surface of the secondary backing is adhered to the back surface of the primary backing component by the adhesive composition, and the polymer film is disposed on the second surface of the secondary backing and wherein a first portion of the polymer film is adhered to the primary backing component and a second portion of the polymer film is adhered to the second surface of the secondary backing.

[00137] The adhesive composition can be provided by any means known to one of ordinary skills in the art, including, but not limited to, a dispensing apparatus, an extrusion station, a sprayer for a liquefied adhesive composition, or a lick roll rotating with a pan, which contains the liquefied adhesive composition. Nip rollers **218**, may be heated by any means that are known to those having ordinary skill in the art to which the invention relates.

[00138] One skilled in the art will appreciate that, notwithstanding the particular examples described above, it is contemplated that the carpet may be produced by the processes known to those skilled in the art, including but not limited to direct coating and roll metering, and knife-coating and lick-roll application, as described in D. C. Blackly, *Latex and Textiles*, section 19.4.2, page 361, which is incorporated herein by reference.

C. EXPERIMENTAL

[00139] The following examples are put forth so as to provide those of ordinary skill in the art with a complete disclosure and description of how the compounds, compositions, articles, devices and/or methods claimed herein are made and evaluated, and are intended to be purely exemplary of the invention and are not intended to limit the scope of what the inventors regard as their invention. Efforts have been made to ensure accuracy with respect to numbers (*e.g.*, amounts, temperature, etc.), but some errors and deviations should be accounted for. Unless indicated otherwise, parts are parts by weight, temperature is in °C or is at ambient temperature, and pressure is at or near atmospheric.

[00140] Experiment 1

[00141] In this experiment, the liquid penetration and wicking properties of two inventive carpet samples (Sample A and B) were analyzed. **FIG. 3** illustrates a visual result of the test. Samples A and B are nearly identical carpet products of the present invention, each comprised generally of a greige good having a thermoplastic adhesive composition applied to the back surface of the primary backing component and secondary backing and polymeric film co-laminated thereon pursuant to the methods described herein. The difference between test samples A and B was the type of secondary backing used. The secondary backing of Sample A was a 14 x 4.5 pick, leno weave comprised of slit-film warp yarns and slit weft yarns (also referred as a tape-tape secondary backing). The secondary backing of Sample A is a Style S8880 manufactured by Shaw Industries Group, Inc. An illustration of this secondary backing is illustrated in **FIG. 4.** The secondary backing of Sample B was a standard 16 x 4.5 pick, leno weave polypropylene secondary backing, wherein the weft yarn in this style of secondary backing is comprised of a spun polypropylene fiber. It is understood that the term “pick” represents the number of weft yarns shuttled across the warp yarns. The secondary backing of Sample B is a Style S8749 manufactured by Shaw Industries Group, Inc. An illustration of the tape/spun or spun secondary backing of sample B is shown in **FIG. 5**.

[00142] The British Spill Test was performed on both samples by dropping 100 ml of a red dye solution from a distance of 1 meter onto the face of the carpet at three different locations. After 24 hours the samples were examined for a pass/fail rating based on penetration of the red dye through the carpet and onto the absorbent paper underneath the carpet. Both samples were rated as passing the liquid penetration as the essentially none of the dye testing liquid was able to penetrate the polyethylene film layer of the carpets.

[00143] A difference in wicking characteristics exhibited by the two samples was, however, observed. Specifically, it can be seen from the illustrations of FIG 3. that the red dye dropped on Sample B, penetrated the carpet product to the secondary backing and then wicked to the edge of the carpet product via capillary action of the spun weft yarns present in the secondary backing. The polyethylene film adjacent to the secondary backing contained the liquid and the full penetration of the dye through the carpet was prevented. These results demonstrated that while the full penetration of the dye through the carpet can be prevented by the presence of the polyethylene film adjacent to the secondary carpet, the cleaning of such

carpet could be difficult if the liquid is allowed to penetrate and then to wick to a large area beyond the point of contact of the dye and the carpet.

[00144] In contrast, it can be seen that the red dye dropped onto Sample A remained confined to a relatively small area. These results show that combination of a tape-tape secondary backing and a polyethylene film adjacent to it provides a carpet product having excellent spill resistant properties, including both liquid penetration resistance and enhanced wicking performance.

[00145] Experiment 2

[00146] In this experiment, the relative wicking performance of the two secondary backing materials utilized in Samples A and B of experiment 1 were analyzed. A specimen of each backing material (the tape/tape of Sample A and tape/spun of Sample B) measuring approximately 7.5 cm x 23 cm was used. 25 ml of the red dye solution used for British Spill Testing was placed into a weighing tray. End portions of each specimen were then placed into the dye solution and weighted with a paper clip as shown in **FIG. 6**. The dye placed on the “spun” specimen of Sample B (as illustrated in **FIG. 5)** wicked to the edge of the specimen in approximately 4.5 min. In contrast, there was no evidence of wicking after 4.5 min of exposure to the dye solution for the “tape/tape” specimen of Sample A (as illustrated in **FIG. 4)**. It can be seen from this experiment that a tape/tape type secondary backing has the added advantage of minimizing, reducing, or even eliminating undesired wicking of a spilled liquid.

CLAIMS:

1. A carpet comprising:

   (a) a greige good comprising:

      i) a primary backing component having a face surface and a back surface; and

      ii) a plurality of fibers attached to the primary backing component and extending from the face surface of the primary backing component;

   (b) an adhesive composition applied to the back surface of the primary backing component;

   (c) a secondary backing having a first surface and a second surface, wherein the first surface of the secondary backing is adhered to the back surface of the primary backing component by the adhesive composition; and

   (d) a polymer film disposed on the second surface of the secondary backing, wherein a first portion of the polymer film is adhered to the primary backing component and a second portion of the polymer film is adhered to the second surface of the secondary backing.

2. The carpet of claim 1, wherein the plurality of fibers comprises a polyamide, an olefin, or a polyester.

3. The carpet of claims 1 or 2, wherein the plurality of fibers are present in yarn.

4. The carpet of any one of claims 1-3, wherein a portion of the plurality of fibers are exposed at the back surface of the primary backing component.

5. The carpet of any one of claims 1-4, wherein the greige good comprises a precoat layer disposed between the back surface of the primary backing component and the adhesive composition.

6. The carpet of claim 5, wherein the precoat layer comprises latex.

7. The carpet of any one of claims 1-6, wherein the adhesive composition comprises a homogeneously branched ethylene polymer.

8. The carpet of claim 7, wherein the homogeneously branched ethylene polymer is an interpolymer of ethylene with at least one C_3-C_{20} α-olefin.

9. The carpet of any one of claims 7, wherein the homogeneously branched ethylene polymer is copolymer of ethylene and one C_3-C_{20} α -olefin.

10. The carpet of any one of claims 8-9, wherein the one C_3-C_{20} α -olefin is selected from the group consisting of propylene, 1-butene, 1-isobutylene, 1-pentane, 1-hexane, 4-methyl-1-pentene, 1-heptene, and 1-octane.

11. The carpet of any one of claims 8-10, wherein the one C_3-C_{20} α -olefin is 1-octane.

12. The carpet of any one of claims 7-11, wherein the at least one homogeneously branched ethylene polymer is homogeneously branched linear ethylene polymer.

13. The carpet of any one of claims 1-12, wherein the adhesive composition is present in an amount of about 10 ounces/sq. yard or less.

14. The carpet of any one of claims 1-13, wherein the adhesive composition is present in an amount of about 3 to about 8 ounces/sq. yard.

15. The carpet of any of claims 1-14, wherein the primary backing component comprises a plurality of primary backing layers.

16. The carpet of any one of claims 1-15, wherein the primary backing component comprises a polyolefin, a polyester, a polyamide, or a combination thereof.

17. The carpet of any one of claims 1-16, wherein the primary backing component comprises a polyolefin.

18. The carpet of claim 17, wherein the polyolefin comprises polypropylene.

19. The carpet of any one of claims 1-16, wherein the primary backing component comprises polyester.

20. The carpet of any one of claims 1-17, wherein the primary backing component comprises a polyamide.

21. The carpet of any one of claims 1-16, wherein the primary backing component comprises a combination of polyester and polyamide.

22. The carpet of claims 20 or 21, wherein the polyamide is nylon.

23. The carpet of any one of claims 1-22, wherein the primary backing component is a sheath-core primary backing component.

24. The carpet of any one of claims 1-23, wherein the secondary backing comprises a woven material.

25. The carpet of any one of claims 1-24, wherein the secondary backing comprises a tape-tape yarn, a tape-spun yarn, or a combination thereof.

26. The carpet of claims 24 or 25, wherein the secondary backing is a tape-tape yarn woven material.

27. The carpet of any one of claims 1-26, wherein the secondary backing comprises a polyolefin.

28. The carpet of claims 27, wherein the polyolefin comprises polypropylene.

29. The carpet of any one of claims 1-28, wherein the polymer film is a fluid barrier.

30. The carpet of any one of claims 1-29, wherein the polymer film is impermeable to gases.

31. The carpet of any one of claims 1-30, wherein the polymer film is a thermoplastic film.

32. The carpet of any one of claims 1-31, wherein the polymer film comprises polyethylene, polypropylene, polyurethane, polyester, polyvinylchloride, or a combination thereof.

33. The carpet of claim 32, wherein the polymer film is polyethylene.

34. The carpet of claim 32, wherein the polymer film is a combination of polyethylene and polyester.

35. The carpet of any one of claims 1-34, wherein the polymer film has a thickness of less than about 6 mils.

36. The carpet of claim 35, wherein the polymer film has a thickness of about 2 to about 4 mils.

37. The carpet of any one of claim 1-34, wherein the polymer film has a thickness of about 30 to about 50 mils.

38. The carpet of any one of claims 1-37, wherein the polymer film is an extruded film.

39. The carpet of any one of claims 1-37, wherein the polymer film is a blown film.

40. The carpet of any one of claims 1-37, wherein the polymer film is a cast film.

41. The carpet of any one of claims 1-37, wherein the polymer film is an engineered film.

42. The carpet of any one of claims 1-41, wherein a controlled spilled test fluid in the British Spill Test remains substantially contained within the point of contact of the test fluid and the carpet.

43. The carpet of any one of claims 1-41, wherein an area of a spill measured in the British Spill Test is not substantially changed from a time of the spill to a 24 hours test period.

44. The carpet of any one of claims 1-41, wherein the carpet passes the British Spill Test.

45. The carpet of any one of claims 1-44, wherein the carpet is a broadloom carpet.

46. The carpet of any one of claims 1-44, wherein the carpet is a turf.

47. The carpet of any one of claims 1-46, wherein the polymer film is impermeable to aqueous fluids.

48. The carpet of any one of claims 1-47, wherein the polymer film is impermeable to non-aqueous fluids.

49. The carpet of claim 48, wherein the non-aqueous fluid is an organic fluid.

50. The carpet of any one of claims 1-49, wherein the adhesive composition forms an adhesive layer and wherein the carpet comprises one adhesive layer.

51. A carpet comprising:

    (a) a greige good comprising:

        i) a primary backing component having a face surface and a back surface;

        ii) a plurality of fibers attached to the primary backing component and extending from the face surface of the primary backing component;

    (b) an adhesive composition applied to the back surface of the primary backing component;

    (c) a woven tape-tape yarn secondary backing having a first surface and a second surface, wherein the first surface of the secondary backing is adhered to the back surface of the primary backing component by the adhesive composition; and

    (d) a polymer film disposed on the second surface of the secondary backing, wherein a first portion of the polymer film is adhered to the primary backing component and a second portion of the polymer film is adhered to the second surface of secondary backing.

52. The carpet of claim 51, wherein the plurality of fibers comprises a polyamide, an olefin, or a polyester.

53. The carpet of claims 51 or 52, wherein the plurality of fibers are present in yarn.

54. The carpet of any one of claims 51-53, wherein the plurality of fibers is exposed at the back surface of the primary backing component.

55. The carpet of any one of claims 51-54, wherein a portion of the plurality of fibers are exposed at the back surface of the primary backing component.

56. The carpet of any one of claims 51-55, wherein the greige good comprises a precoat layer disposed between the back surface of the primary backing component and the adhesive composition.

57. The carpet of claim 56, wherein the precoat layer comprises latex.

58. The carpet of any one of claims 51-57 wherein the adhesive composition comprises a homogeneously branched ethylene polymer.

59. The carpet of claim 58, wherein the homogeneously branched ethylene polymer is an interpolymer of ethylene with at least one C_3-C_{20} α-olefin.

60. The carpet of claim 58, wherein the homogeneously branched ethylene polymer is copolymer of ethylene and one C_3-C_{20} α -olefin.

61. The carpet of any one of claims 58-60, wherein the one C_3-C_{20} α -olefin is selected from the group consisting of propylene, 1-butene, 1-isobutylene, 1-pentane, 1-hexane, 4-methyl-1-pentene, 1-heptene, and 1-octane.

62. The carpet of any one of claims 58-61, wherein the one C_3-C_{20} α -olefin is 1-octane.

63. The carpet of any one of claims 58-62, wherein the at least one homogeneously branched ethylene polymer is homogeneously branched linear ethylene polymer.

64. The carpet of any one of claims 51-63, wherein the adhesive composition is present in an amount of about 10 ounces/sq. yard or less.

65. The carpet of any one of claims 51-64, wherein the adhesive composition is present in an amount of about 3 to about 8 ounces/sq. yard.

66. The carpet of any one of claims 51-65, wherein the primary backing component comprises a plurality of primary backing layers.

67. The carpet of any one of claims 51-66, wherein the primary backing component comprises a polyolefin, a polyester, a polyamide, or a combination thereof.

68. The carpet of any one of claims 51-67, wherein the primary backing component comprises a polyolefin.

69. The carpet of claim 68, wherein the polyolefin polymer comprises polypropylene.

70. The carpet of any one of claims 51-67, wherein the primary backing component comprises a polyester.

71. The carpet of any one of claims 51-67, wherein the primary backing component comprises a polyamide.

72. The carpet of any one of claims 51-67, wherein the primary backing component comprises a combination of polyester and polyamide.

73. The carpet of claims 71 or 72, wherein the polyamide is nylon.

74. The carpet of any one of claims 51-73, wherein the primary backing component is a sheath-core primary backing component.

75. The carpet of any one of claims 51-74, wherein the secondary backing comprises a polyolefin.

76. The carpet of claims 75, wherein the polyolefin comprises polypropylene.

77. The carpet of any one of claims 51-76, wherein the polymer film is a fluid barrier.

78. The carpet of any one of claims 51-77, wherein the polymer film is impermeable to gases.

79. The carpet of any one of claims 51-78, wherein the polymer film is a thermoplastic film.

80. The carpet of any one of claims 51-79, wherein the polymer film comprises polyethylene, polypropylene, polyurethane, polyester, polyvinylchloride, or a combination thereof.

81. The carpet of claim 80, wherein the polymer film is polyethylene.

82. The carpet of claim 80, wherein the polymer film is a combination of polyethylene and polyester.

83. The carpet of any one of claim 51-82, wherein the polymer film has a thickness of less than about 6 mils.

84. The carpet of claim 83, wherein the polymer film has a thickness of about 2 to about 4 mils.

85. The carpet of nay one of claims 51-82, wherein the polymer film has a thickness of about 3- to about 50 mils.

86. The carpet of any one of claims 51-85, wherein the polymer film is an extruded film.

87. The carpet of any one of claims 51-85, wherein the polymer film is a blown film.

88. The carpet of any one of claims 51-85, wherein the polymer film is a casted film.

89. The carpet of any one of claims 51-85, wherein the polymer film is an engineered film.

90. The carpet of any one of claims 51-90, wherein a controlled spilled test fluid in the British Spill Test remains substantially contained within the point of contact of the test fluid and the carpet.

91. The carpet of any one of claims 51-90, wherein an area of a spill measured in the British Spill Test is not substantially changed from a time of the spill to a 24 hours test period.

92. The carpet of any one of claims 51-91, wherein the carpet passes the British Spill Test.

93. The carpet of any one of claims 51-92, wherein the carpet is a broadloom carpet.

94. The carpet of any one of claims 51-93, wherein the carpet is a turf.

95. The carpet of any one of claims 51-94, wherein the polymer film is impermeable to aqueous fluids.

96. The carpet of any one of claims 51-95, wherein the polymer film is impermeable to non-aqueous fluids.

97. The carpet of claim 96, wherein the non-aqueous fluid is an organic fluid.

98. The carpet of any one of claims 51-97, wherein the adhesive composition forms an adhesive layer and wherein the carpet comprises one adhesive layer.

99. A method of making a carpet comprising:

(a) providing a greige good comprising:

i) a primary backing component having a face surface and a back surface;

ii) a plurality of fibers attached to the primary backing component and extending from the face surface of the primary backing component;

(b) applying an adhesive composition to the back surface of the primary backing component;

(c) co-laminating a secondary backing and a polymer film to the back surface of the primary backing component such that

i) a first surface of the secondary backing is adhered to the back surface of the primary backing component by the adhesive composition, and

ii) a first portion of the polymer film is adhered to the primary backing component and a second portion of the polymer film is adhered to a second surface of the secondary backing.

100. The method of claim 99, wherein the plurality of fibers comprises a polyamide, an olefin, or a polyester.

101. The method of claims 99 or 100, wherein the plurality of fibers are present in yarn.

102. The method of any one of claims 99-101, wherein a portion of the plurality of fibers are exposed at the back surface of the primary backing component.

103. The method of any one of claims 99-102, wherein the greige good comprises a precoat layer disposed between the back surface of the primary backing component and the adhesive composition.

104. The method of claim 103, wherein the precoat layer comprises latex.

105. The carpet of any one of claims 99-104, wherein the adhesive composition comprises a homogeneously branched ethylene polymer.

106. The method of claim 104, wherein the homogeneously branched ethylene polymer is an interpolymer of ethylene with at least one C_3-C_{20} α-olefin.

107. The method of claim 104, wherein the homogeneously branched ethylene polymer is copolymer of ethylene and one C_3-C_{20} α -olefin.

108. The method of any one of claims 104-107, wherein the one C_3-C_{20} α -olefin is selected from the group consisting of propylene, 1-butene, 1-isobutylene, 1-pentane, 1-hexane, 4-methyl-1-pentene, 1-heptene, and 1-octane.

109. The method of any one of claims 104-108, wherein the one C_3-C_{20} α -olefin is 1-octane.

110. The method of any one of claims 104-109, wherein the at least one homogeneously branched ethylene polymer is homogeneously branched linear ethylene polymer.

111. The method of any one of claims 99-110, wherein the adhesive composition is present in an amount of about 10 ounces/sq. yard or less.

112. The method of any one of claims 99-111, wherein the adhesive composition is present in an amount of about 3 to about 8 ounces/sq. yard.

113. The method of any one of claims 99-112, wherein the primary backing component comprises a plurality of primary backing layers.

114. The method of any one of claims 99-113, wherein the primary backing component comprises a polyolefin, a polyester, a polyamide, or a combination thereof.

115. The method of any one of claims 99-114, wherein the primary backing component comprises a polyolefin.

116. The method of claim 115, wherein the polyolefin polymer comprises polypropylene.

117. The method of any one of claims 99-114, wherein the primary backing component comprises a polyester.

118. The method of any one of claims 99-114, wherein the primary backing component comprises a polyamide.

119. The method of any one of claims 99-114, wherein the primary backing component comprises a combination of polyester and polyamide.

120. The method of claims 118 or 119, wherein the polyamide is nylon.

121. The method of any one of claims 99-120, wherein the primary backing component is a sheath-core primary backing component.

122. The method of any one of claims 99-121, wherein the secondary backing comprises a woven material.

123. The method of any one of claims 99-122 wherein the secondary backing comprises a tape-tape yarn, a tape-spun yarn, or a combination thereof.

124. The method of claims 122 or 123, wherein the secondary backing is a tape-tape yarn woven material.

125. The method of any one of claims 99-124, wherein the secondary backing comprises a polyolefin.

126. The method of claims 125, wherein the polyolefin comprises polypropylene.

127. The method of any one of claims 99-126, wherein the polymer film is a fluid barrier.

128. The method of any one of claims 99-127, wherein the polymer film is impermeable to gases.

129. The method of any one of claims 99-128, wherein the polymer film is a thermoplastic film.

130. The method of any one of claims 99-129, wherein the polymer film comprises polyethylene, polypropylene, polyurethane, polyester, polyvinylchloride, or a combination thereof.

131. The method of claim 130, wherein the polymer film is polyethylene.

132. The method of claim 130, wherein the polymer film is a combination of polyethylene and polyester.

133. The method of any one of claim 99-132, wherein the polymer film has a thickness of less than about 6 mils.

134. The method of claim 133, wherein the polymer film has a thickness of about 2 to about 4 mils.

135. The method of any one of claim 99-132, wherein the polymer film has a thickness of about 30 to about 50 mils.

136. The method of any one of claims 99-135, wherein the polymer film is an extruded film.

137. The method of any one of claims 99-135, wherein the polymer film is a blown film.

138. The method of any one of claims 99-135, wherein the polymer film is a cast film.

139. The method of any one of claims 99-135, wherein the polymer film is an engineered film.

140. The method of any one of claims 99-139, wherein a controlled spilled test fluid in the British Spill Test remains substantially contained within the point of contact of the test fluid and the carpet.

141. The method of any one of claims 99-140, wherein an area of a spill measured in the British Spill Test is not substantially changed from a time of the spill to a 24 hours test period.

142. The method of any one of claims 99-141, wherein the carpet passes the British Spill Test.

143. The method of any one of claims 99-142, wherein the carpet is a broadloom carpet.

144. The method of any one of claims 99-143, wherein the carpet is a turf.

145. The method of any one of claims 99-144, wherein the polymer film is impermeable to aqueous fluids.

146. The method of any one of claims 99-145, wherein the polymer film is impermeable to non-aqueous fluids.

147. The method of claim 146, wherein the non-aqueous fluid is an organic fluid.

148. The method of any one of claims 99-147, wherein the adhesive composition forms an adhesive layer and wherein the carpet comprises one adhesive layer.

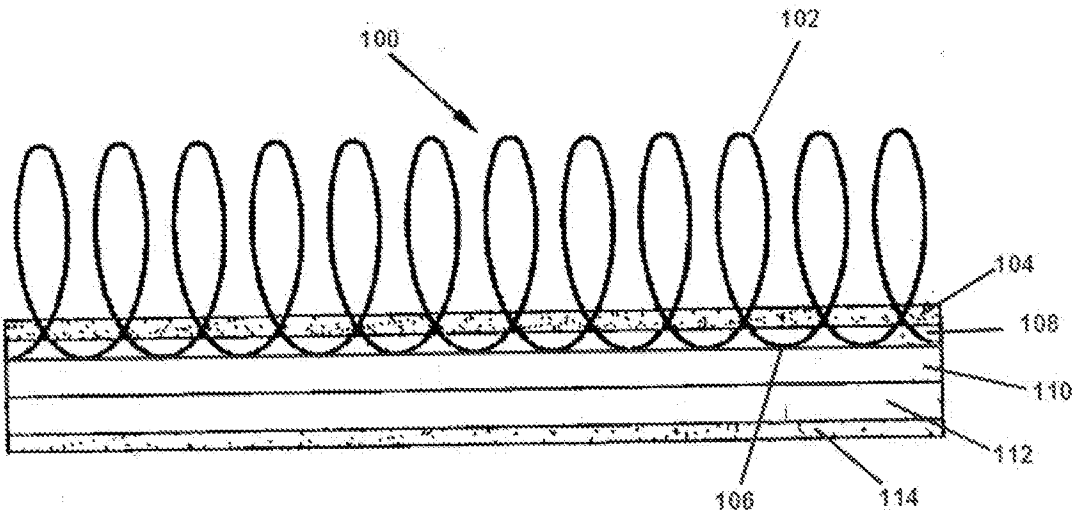

FIG. 1

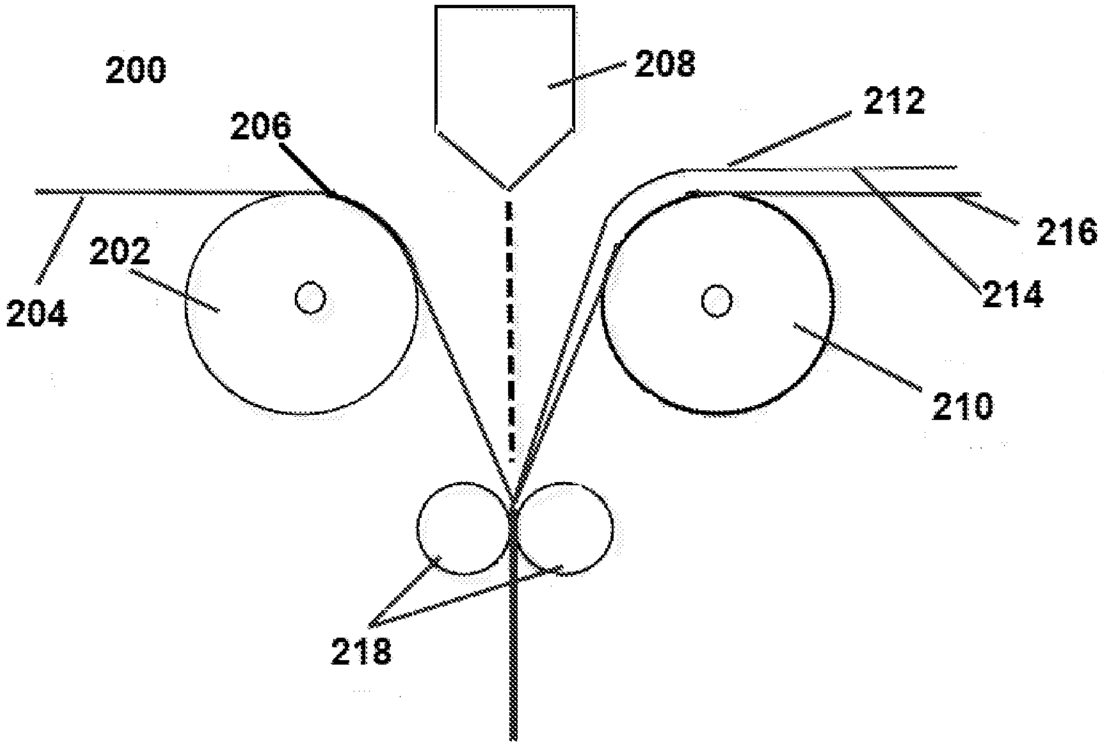

FIG. 2

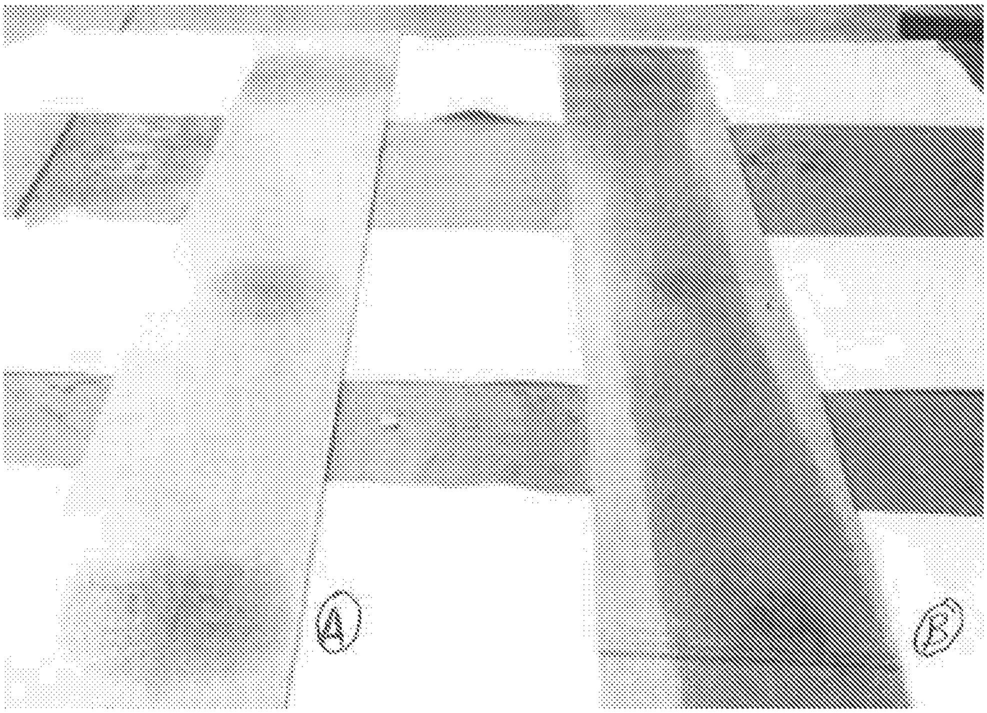

FIG. 3

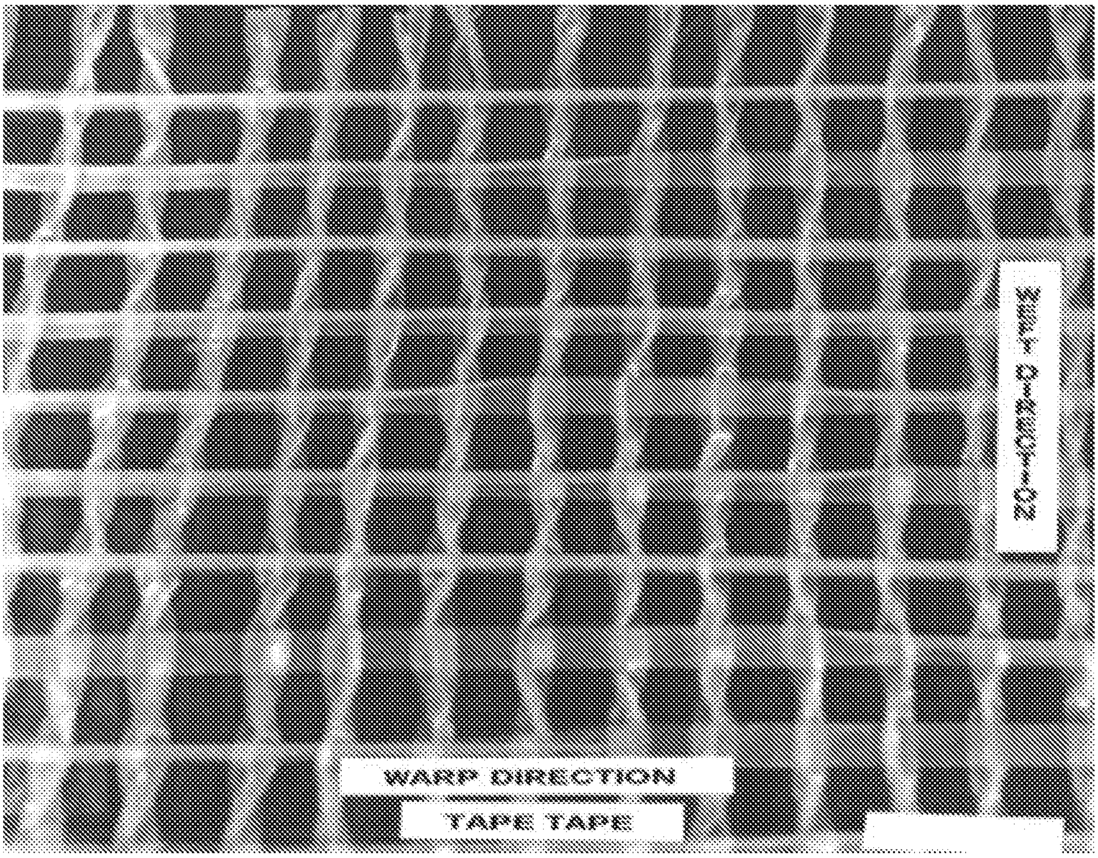

FIG. 4

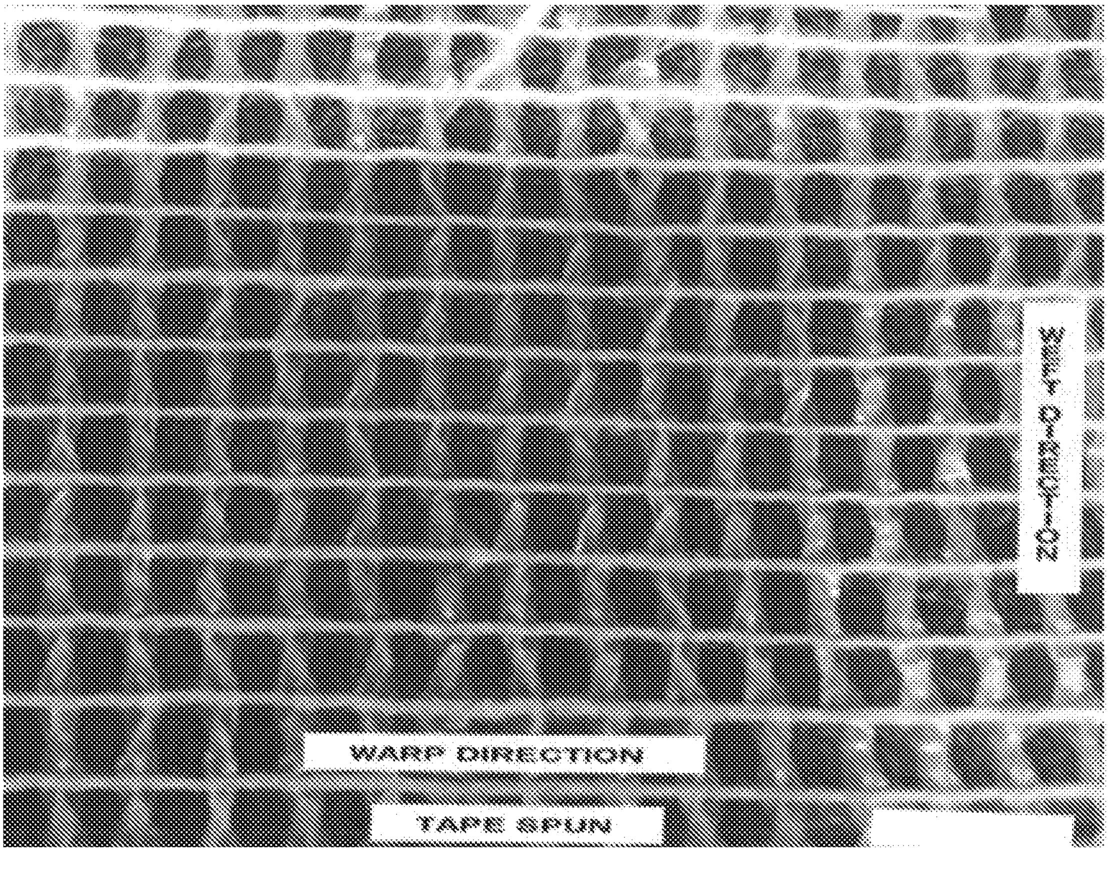

FIG. 5

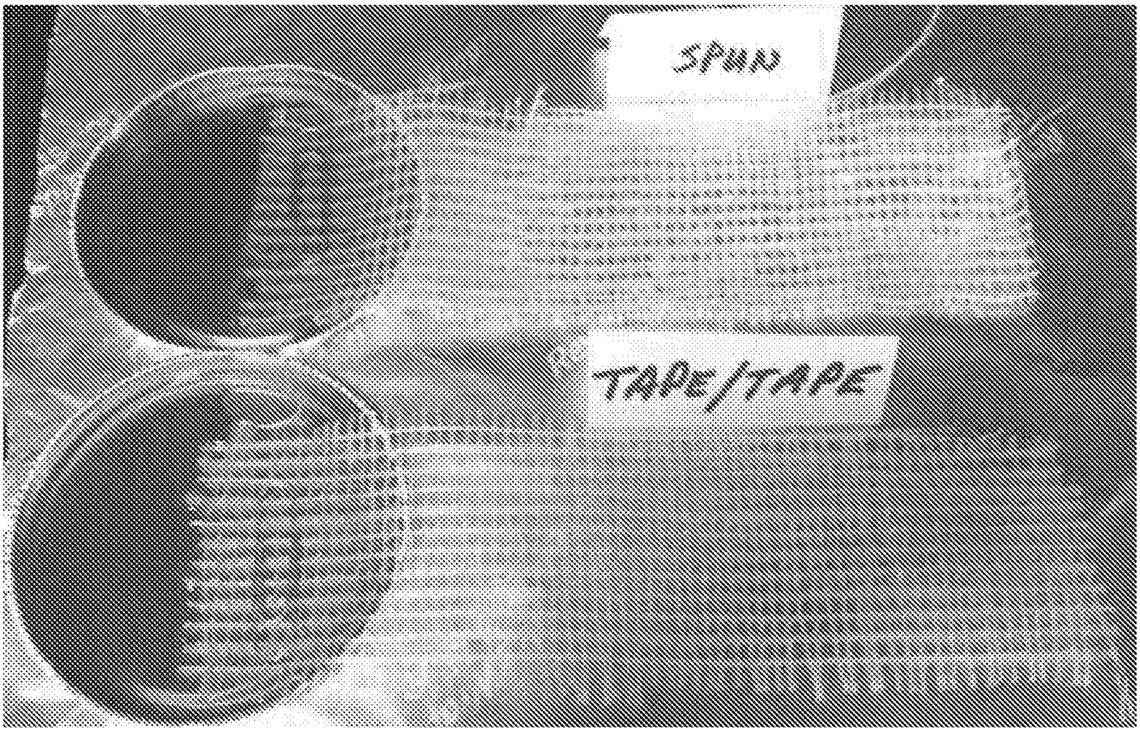

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/040652

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A47G 27/02; A47G 27/00; B32B 27/00; B32B 27/12; D06N 7/00 (2016.01)
CPC - D06N 7/0076; A47G 27/02; B32B 27/12; D06N 7/00; D06N 7/0063; D06N 7/0071 (2016.08)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - A47G 27/00; A47G 27/02; B32B 27/00; B32B 27/12; D06N 7/00 (2016.01)
CPC - A47G 27/02; B32B 27/12; D06N 7/00; D06N 7/0063; D06N 7/0071; D06N 7/0076 (2016.08)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 428/85; 428/95; 442/181; IPC(8) - A47G 27/00; A47G 27/02; B32B 27/00; B32B 27/12; D06N 7/00; CPC - A47G 27/02; B32B 27/12; D06N 7/00; D06N 7/0063; D06N 7/0071; D06N 7/0076 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Orbit, Google Patents, Google
Search terms used: primary, secondary, backing, adhesive, fibers, polymer, film, co-laminate, back, surface, fluid, water, liquid, resistant, impervious, barrier, waterproof, carpet, fabric, textile, laminate, layer, woven, tape-tape, slit film, yarn, warp, weft

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2001/0046581 A1 (BRUMBELOW et al) 29 November 2001 (29.11.2001) entire document	1-3, 51-53, 99-101
Y	US 5,612,113 A (IRWIN, SR) 18 March 1997 (18.03.1997) entire document	1-3, 51-53, 99-101
Y	US 2005/0260380 A1 (MOON et al) 24 November 2005 (24.11.2005) entire document	51-53

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search 10 August 2016	Date of mailing of the international search report 15 SEP 2016
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/040652

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 4-50, 54-98, 102-148
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.