US 20140026290A1

(19) **United States**
(12) **Patent Application Publication**
Howland

(10) **Pub. No.: US 2014/0026290 A1**
(43) **Pub. Date: Jan. 30, 2014**

(54) **THREE DIMENSIONAL GLOVE WITH PERFORMANCE-ENHANCING LAYER LAMINATED THERETO**

(71) Applicant: **Warwick Mills Inc.**, New Ipswich, NH (US)

(72) Inventor: **Charles A. Howland**, Temple, NH (US)

(73) Assignee: **Warwick Mills Inc.**, New Ipswich, NH (US)

(21) Appl. No.: **13/949,279**

(22) Filed: **Jul. 24, 2013**

Related U.S. Application Data

(60) Provisional application No. 61/676,021, filed on Jul. 26, 2012.

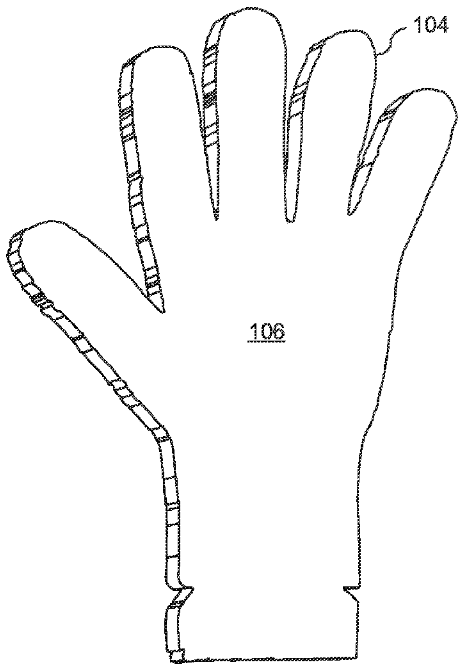
Publication Classification

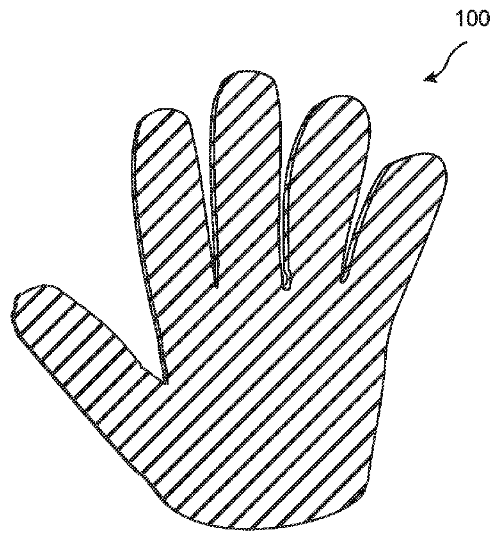
(51) **Int. Cl.**
A41D 19/015 (2006.01)

(52) **U.S. Cl.**
CPC *A41D 19/015* (2013.01)
USPC **2/161.6**; 66/174

(57) **ABSTRACT**

A 3D hand-shaped glove includes a performance-enhancing layer laminated to a fabric glove shell. A flat, solid laminate preform can be prepared with printed graphics, fabric layers, oriented films, dense and/or concentrated fillers, and other features. The 3D hand-shaped glove shell is placed on a 3D laminating form, and the preform is laminated thereto while preserving the 3D shape. In embodiments, the laminating form includes opposing flat surfaces, and a platen or roller press is used. In other embodiments, a bladder or vacuum bag press is used to laminate the preform to a curved or otherwise shaped surface of the laminating form. In embodiments, edge peel resistance is enhanced by extending the perimeter of a low modulus upper layer beyond underlying layers and bonding it directly to the glove shell. Recovery of the glove shell after deformation by the laminating form can provide a warping deformation of the laminate preform.





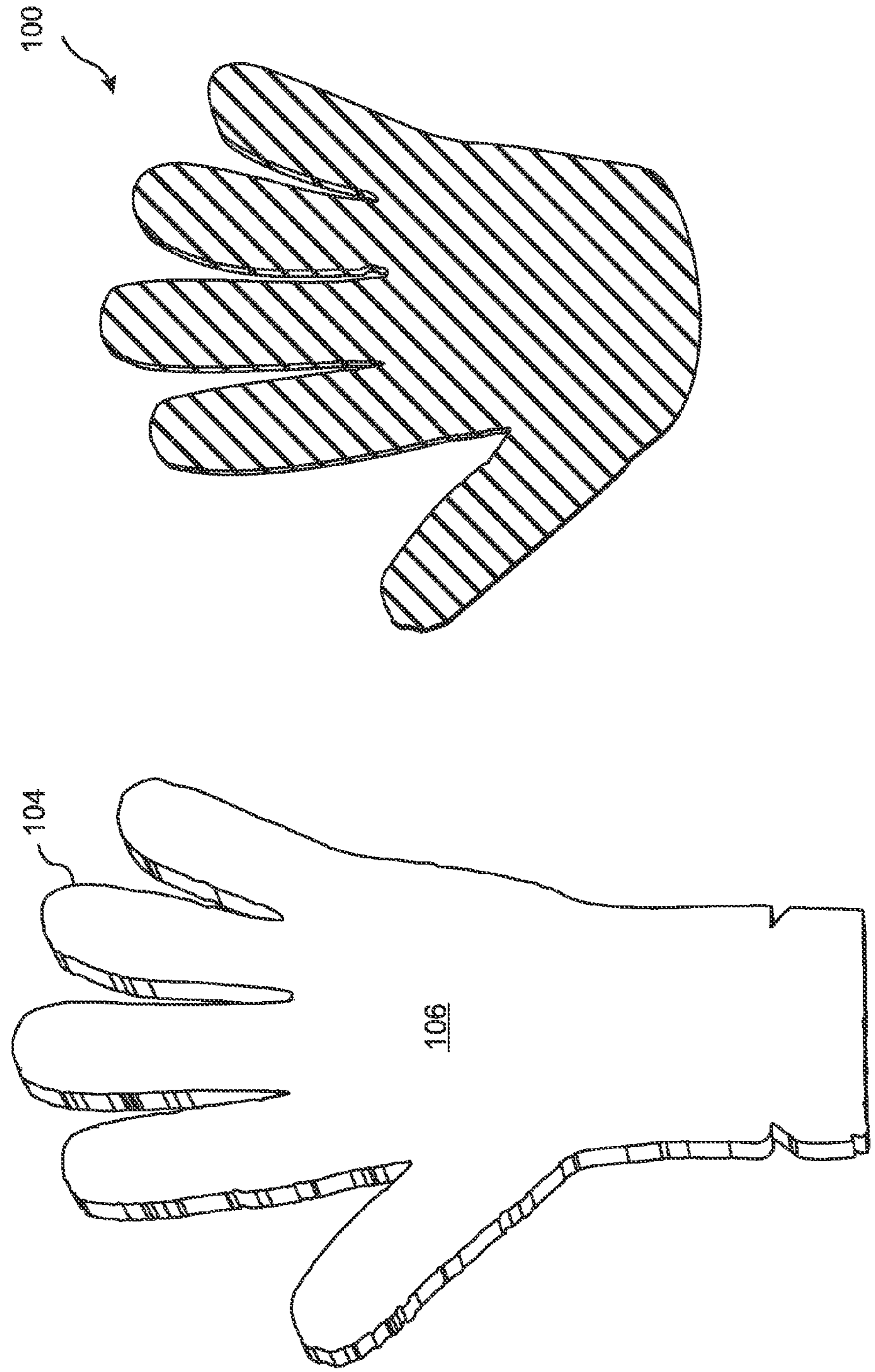


Figure 1A

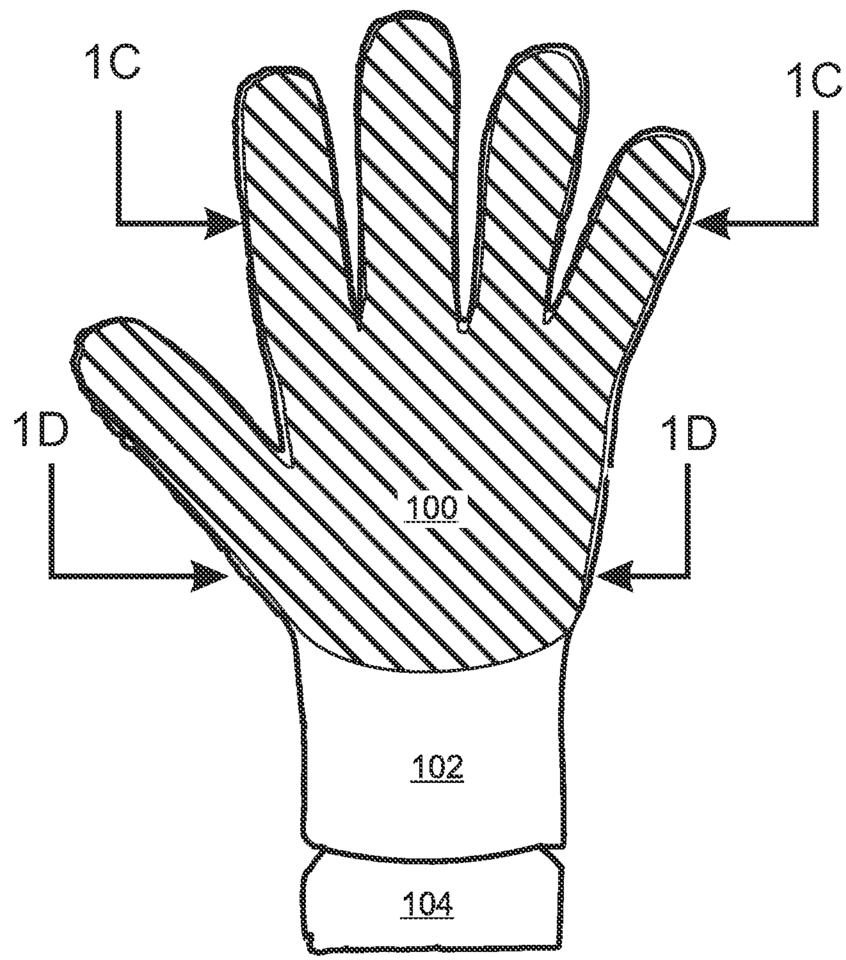


Figure 1B

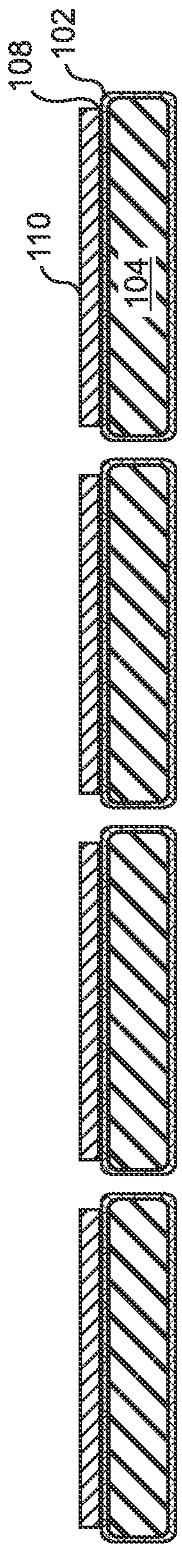


Figure 1C

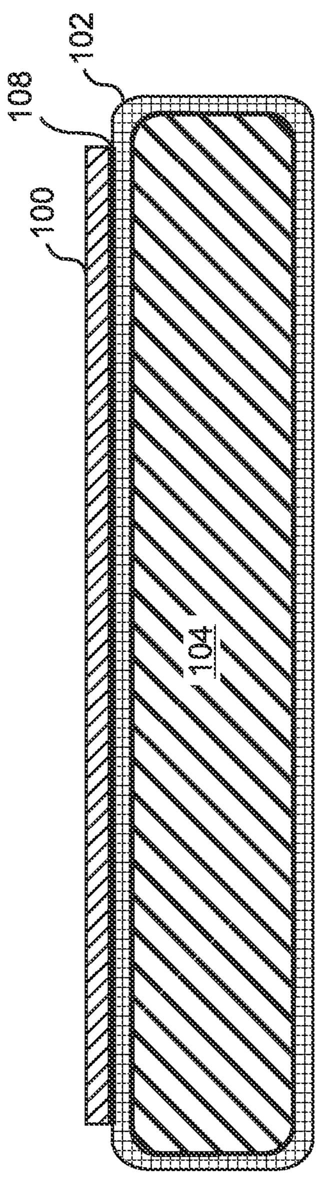


Figure 1D

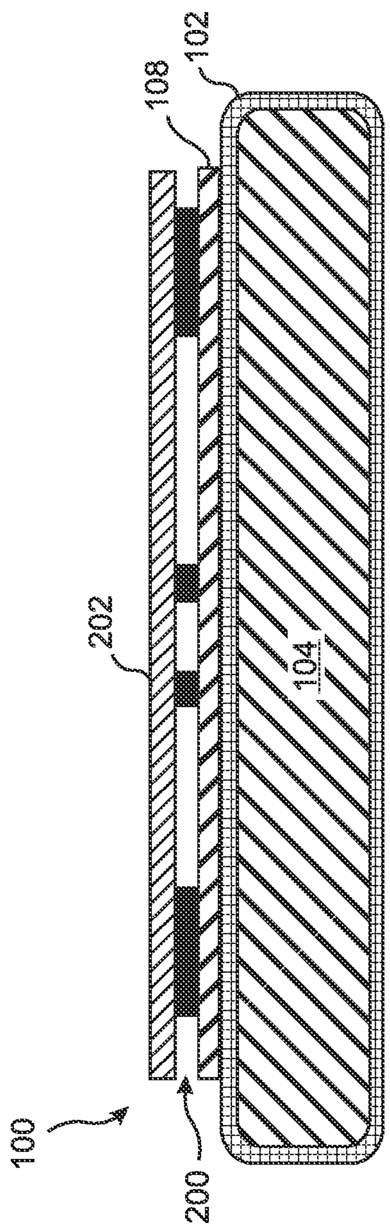


Figure 2A

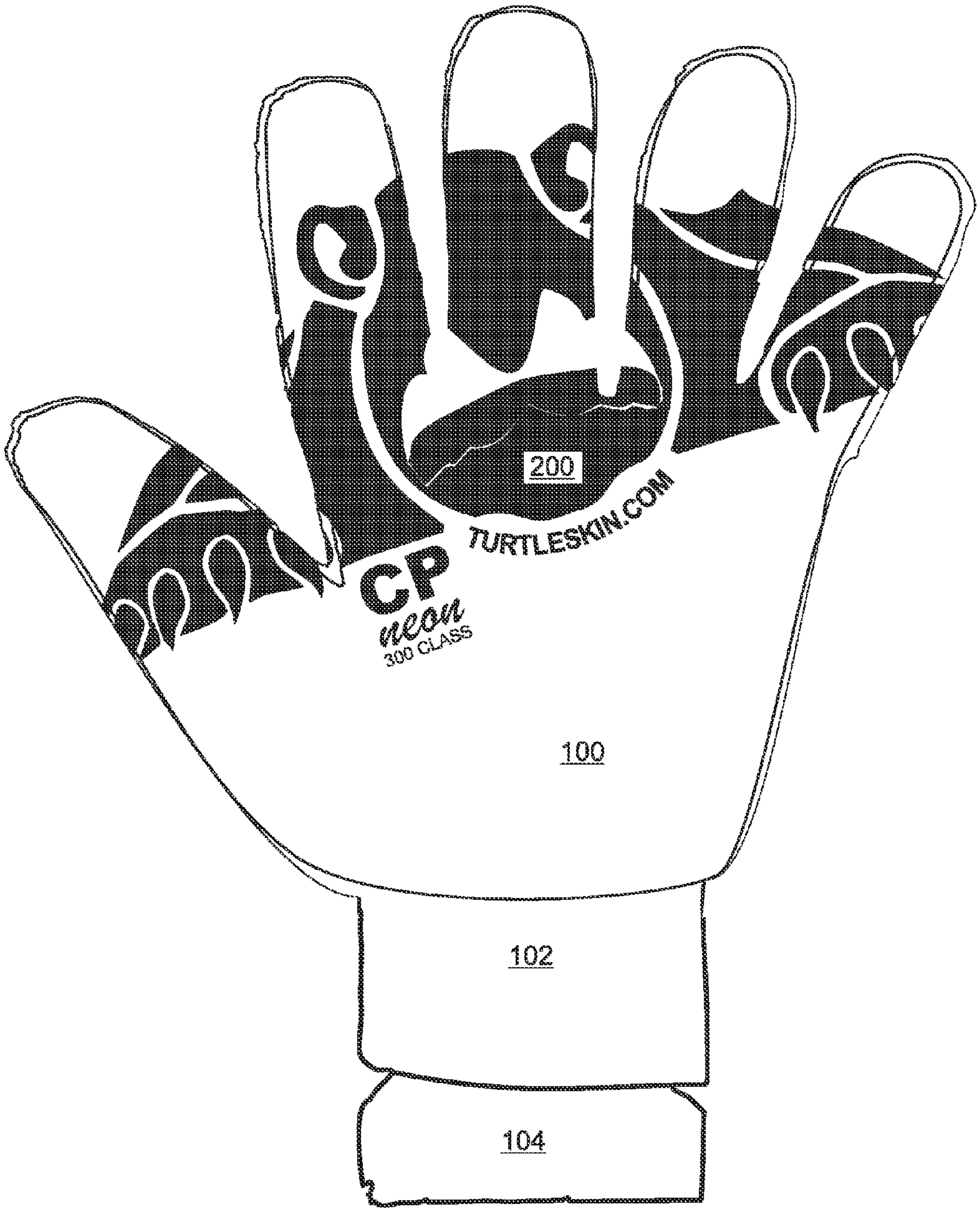


Figure 2B

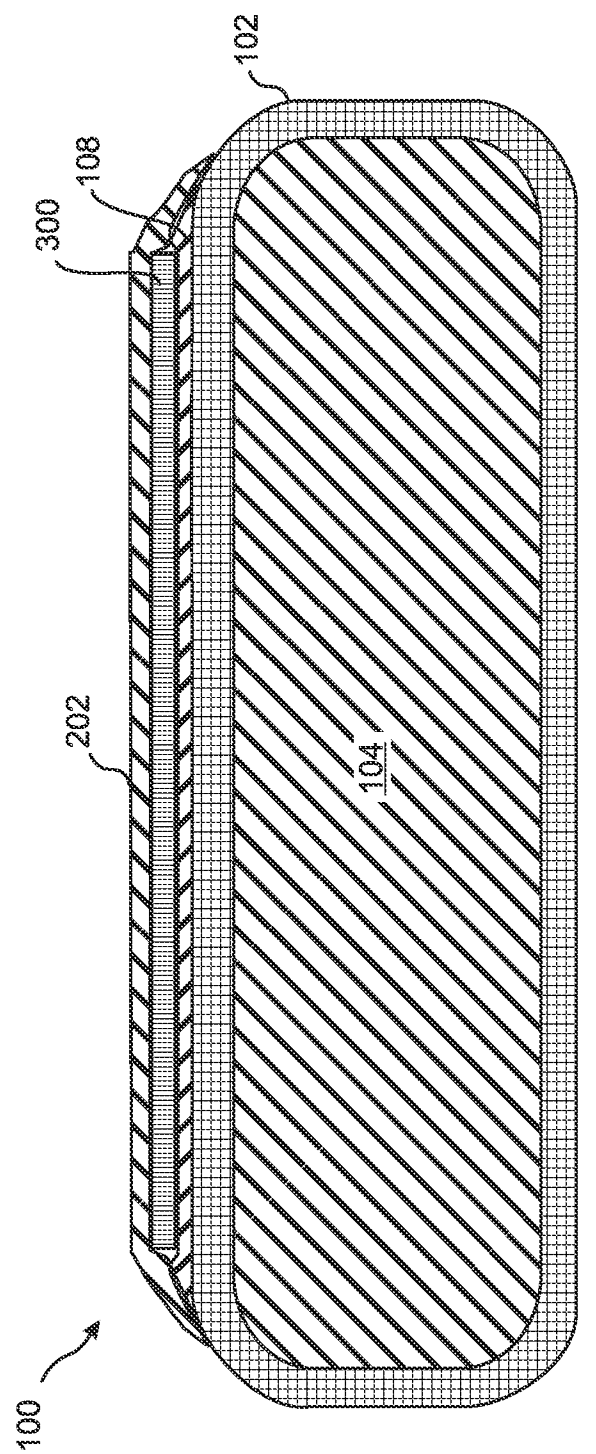


Figure 3

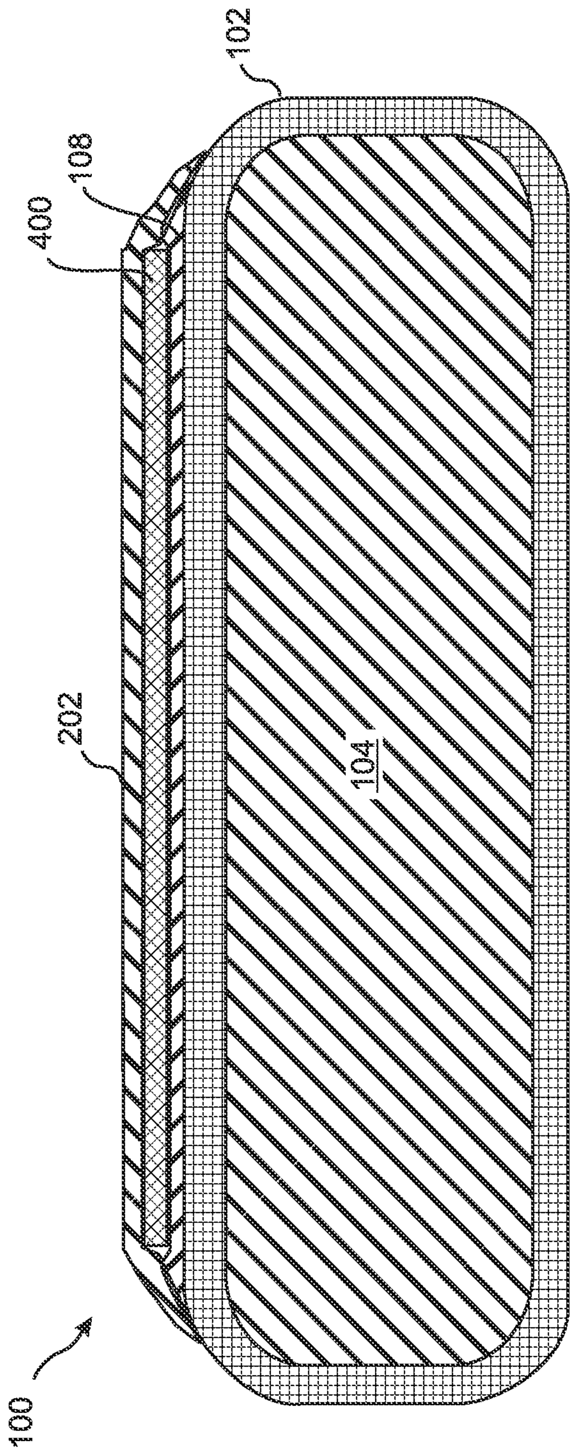


Figure 4

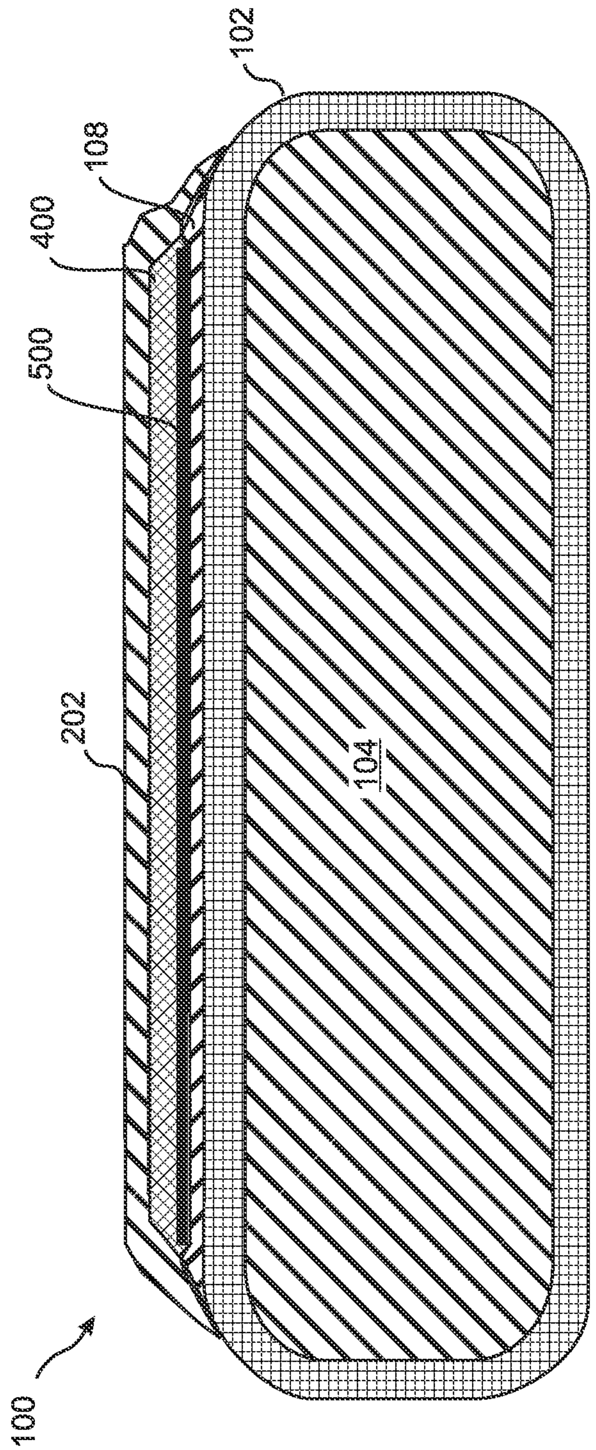


Figure 5

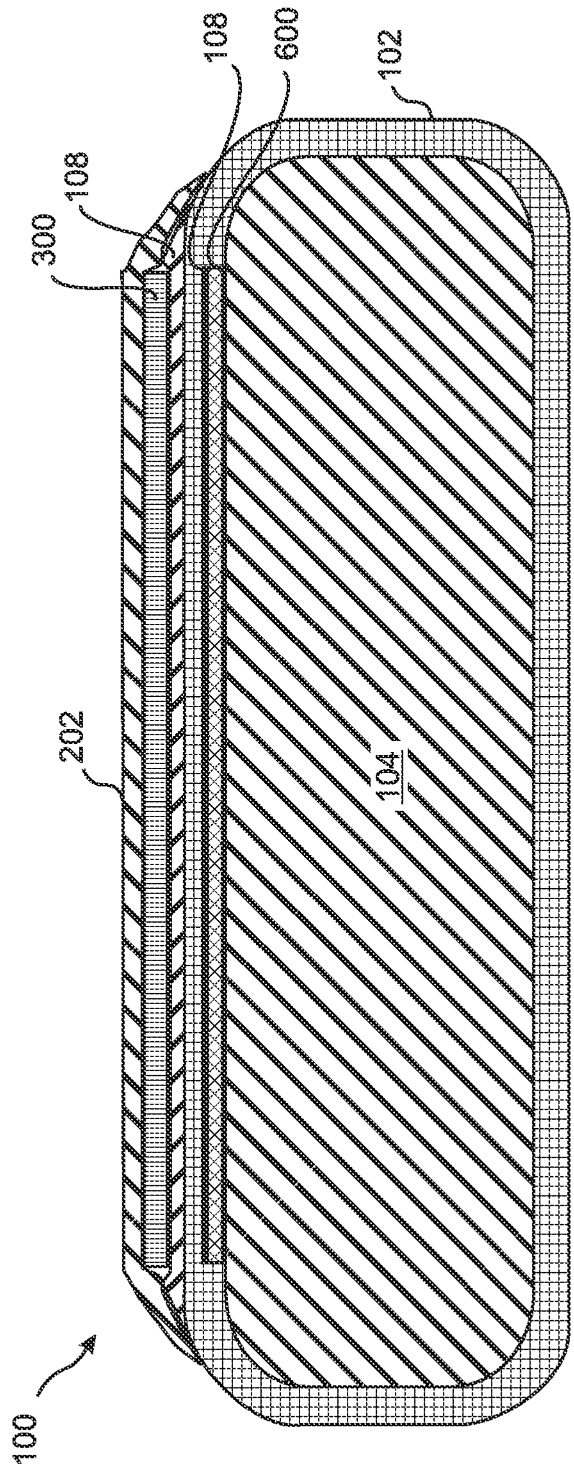


Figure 6

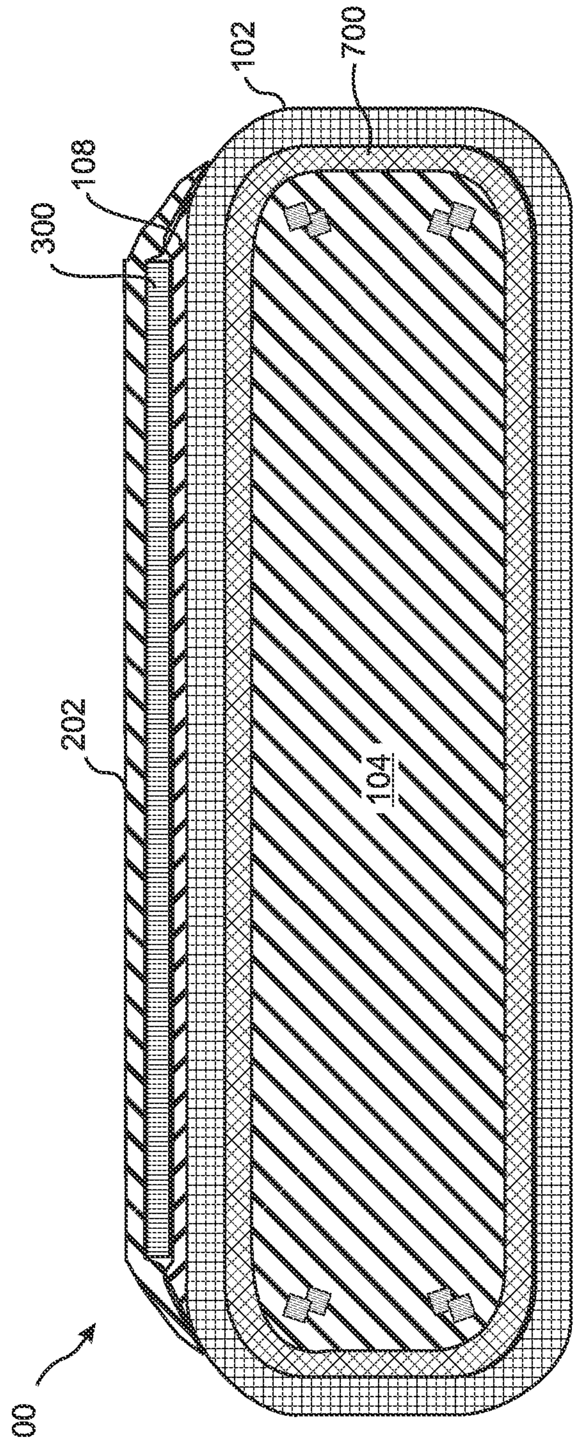


Figure 7

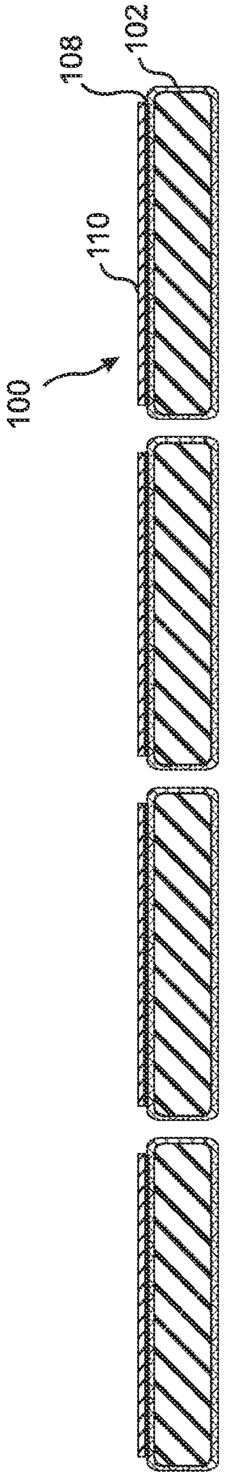


Figure 8A

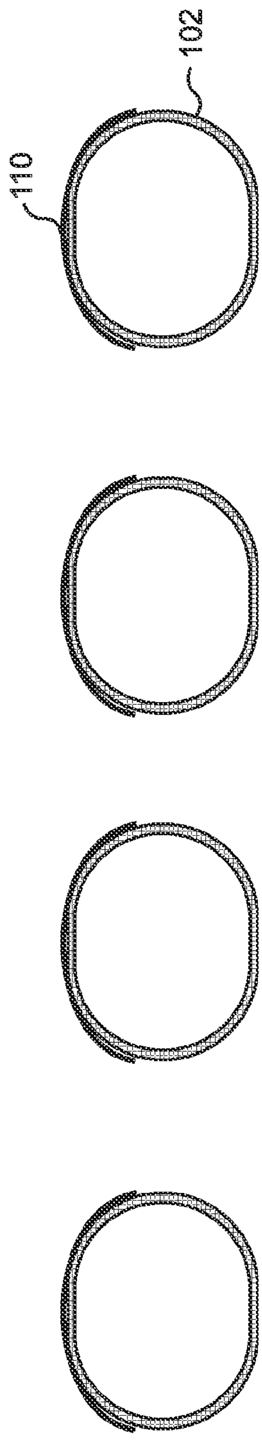


Figure 8B

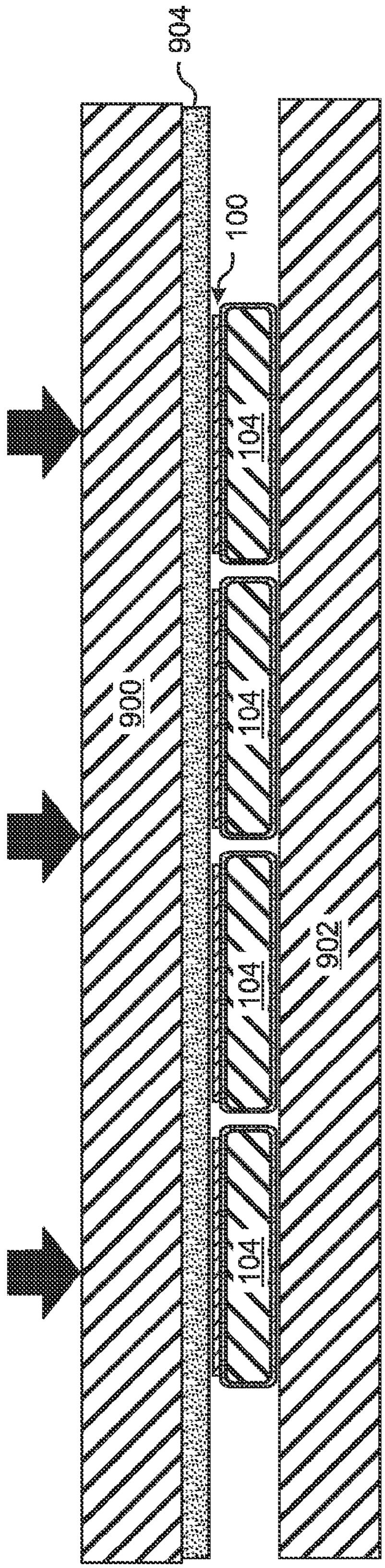


Figure 9

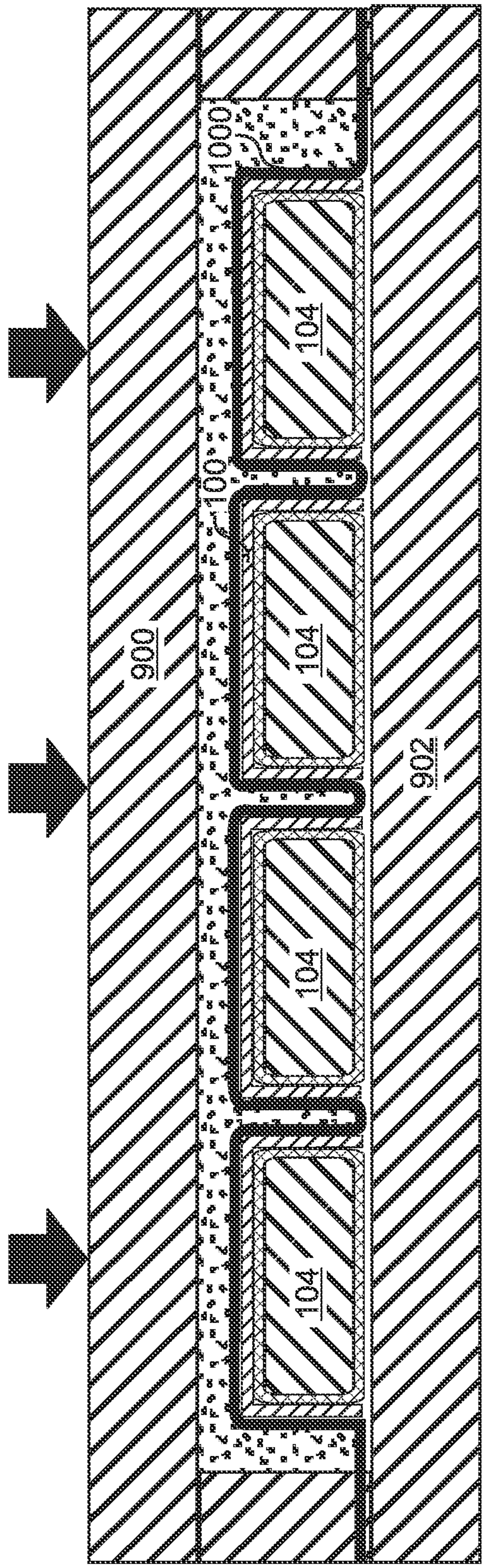


Figure 10

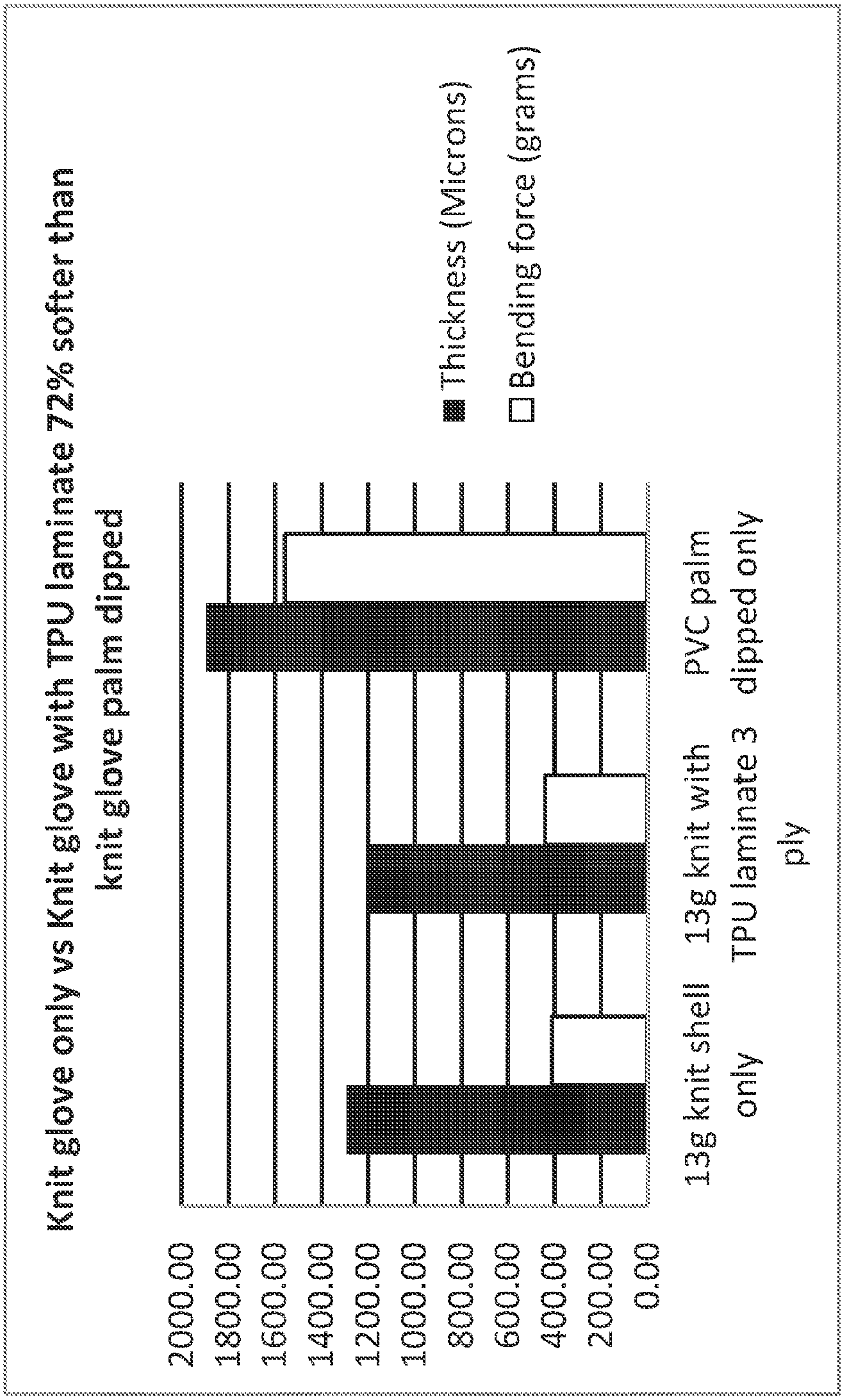

Knit glove only vs Knit glove with TPU laminate 72% softer than knit glove palm dipped
2000.00
1800.00
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
13g knit shell only
13g knit with TPU laminate 3 ply
PVC palm dipped only
Thickness (Microns)
Bending force (grams)

Figure 11A

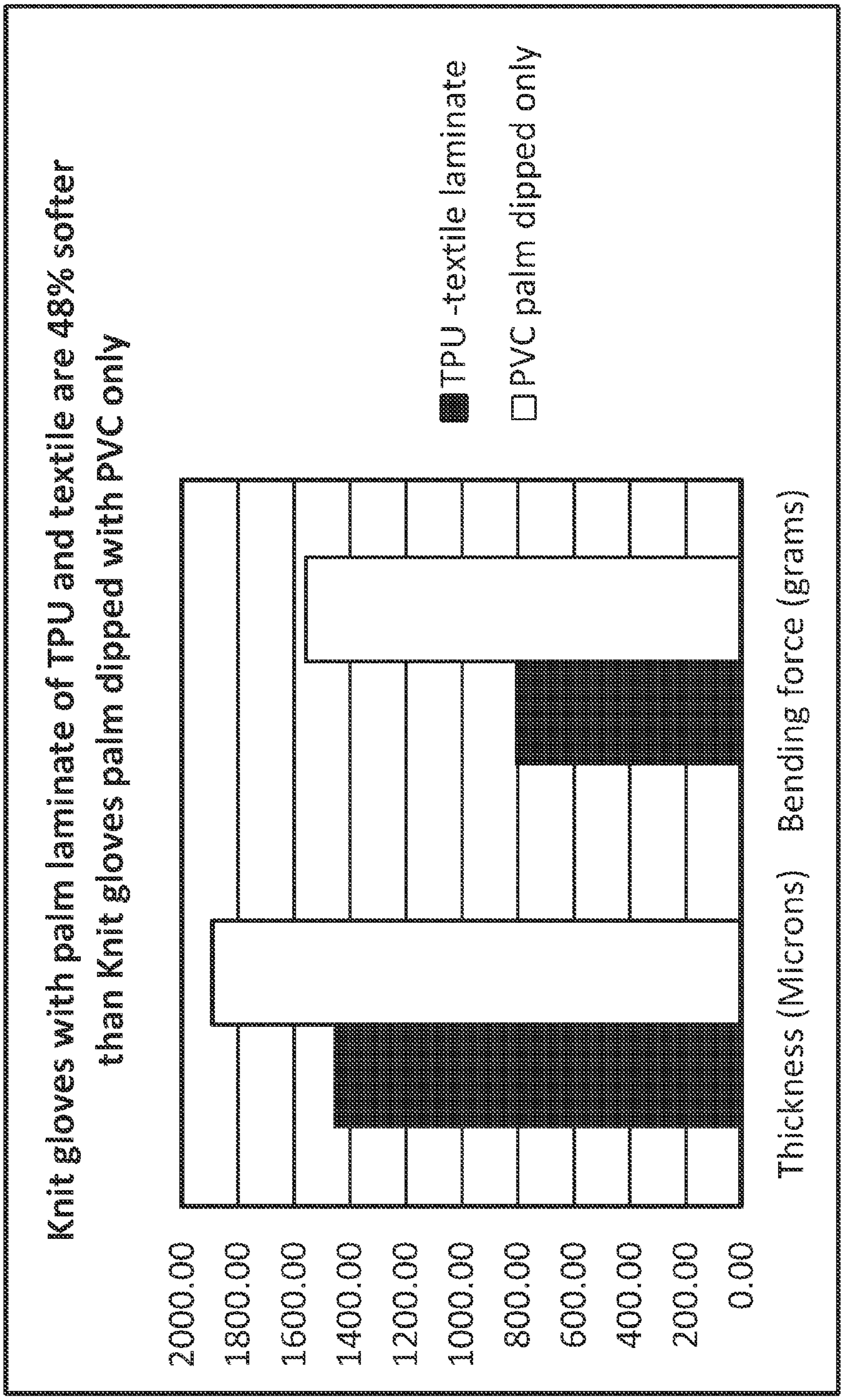

Knit gloves with palm laminate of TPU and textile are 48% softer than Knit gloves palm dipped with PVC only
TPU -textile laminate
PVC palm dipped only
2000.00
1800.00
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
Thickness (Microns)
Bending force (grams)

Figure 11B

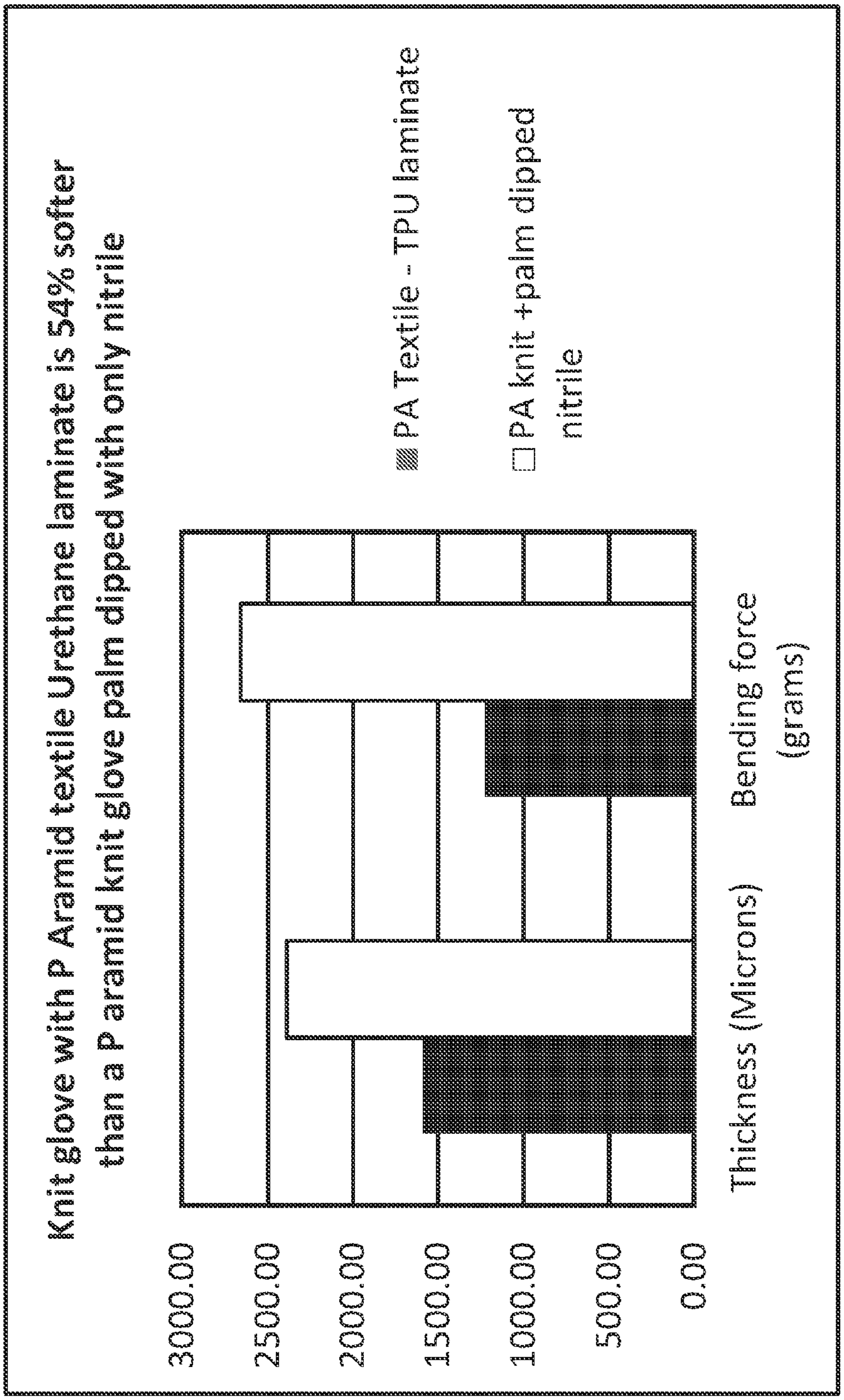

Knit glove with P Aramid textile Urethane laminate is 54% softer than a P aramid knit glove palm dipped with only nitrile
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
Thickness (Microns)
Bending force (grams)
PA Textile - TPU laminate
PA knit +palm dipped nitrile

Figure 11C

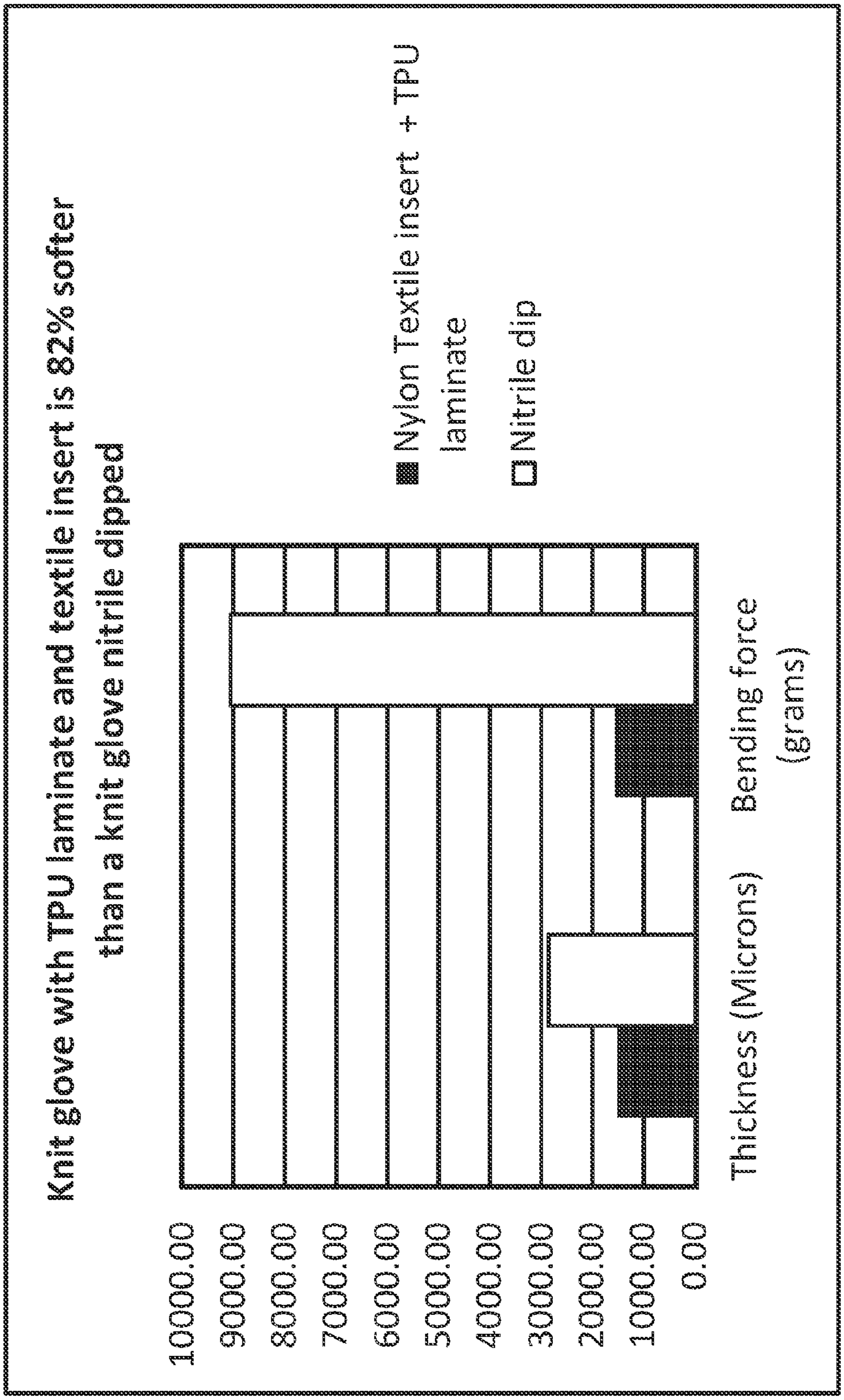

Knit glove with TPU laminate and textile insert is 82% softer than a knit glove nitrile dipped
10000.00
9000.00
8000.00
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
Thickness (Microns)
Bending force (grams)
Nylon Textile insert + TPU laminate
Nitrile dip

Figure 11D

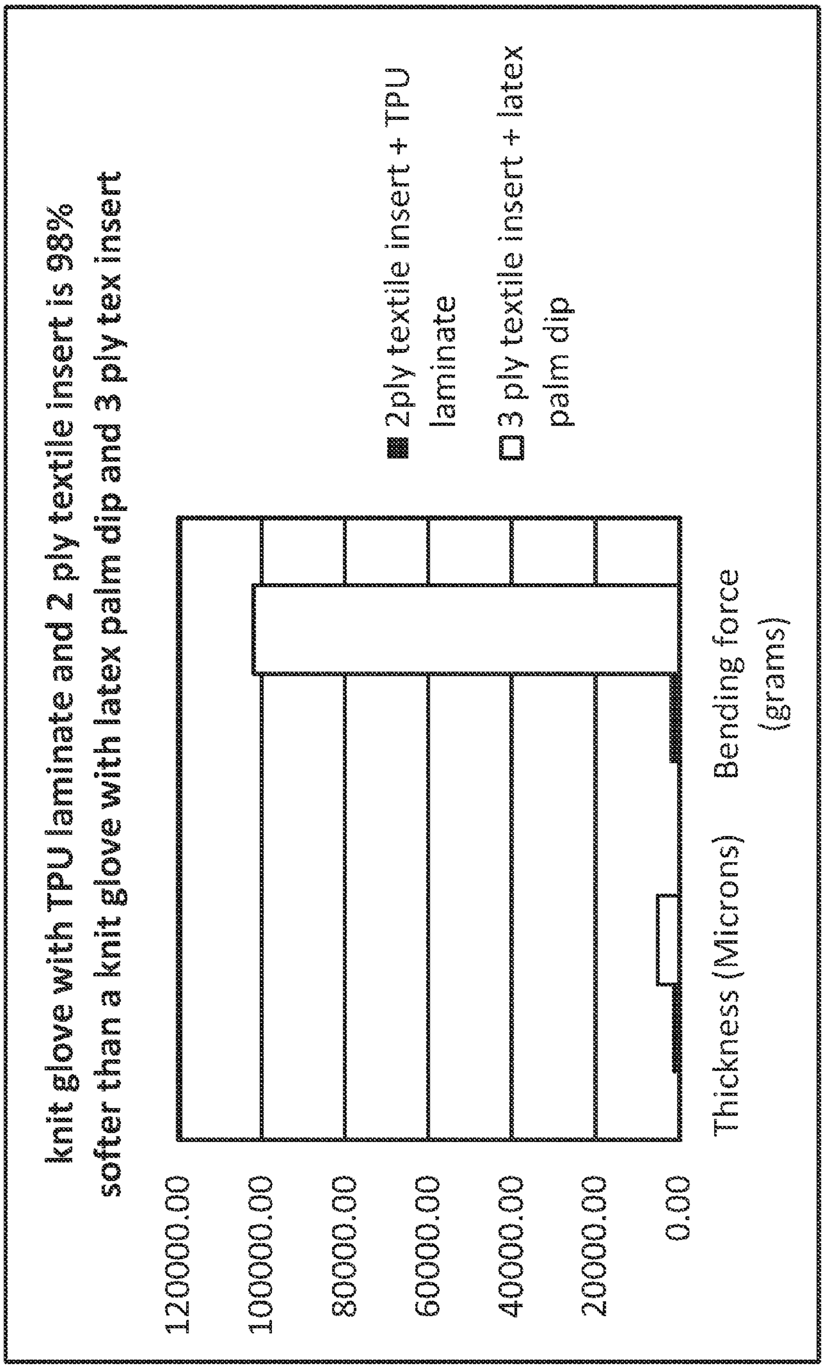

knit glove with TPU laminate and 2 ply textile insert is 98% softer than a knit glove with latex palm dip and 3 ply tex insert
120000.00
100000.00
80000.00
60000.00
40000.00
20000.00
0.00
Thickness (Microns)
Bending force (grams)
2ply textile insert + TPU laminate
3 ply textile insert + latex palm dip

Figure 11E

THREE DIMENSIONAL GLOVE WITH PERFORMANCE-ENHANCING LAYER LAMINATED THERETO

RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 61/676,021, filed Jul. 26, 2012, which is herein incorporated by reference in its entirety for all purposes.

FIELD OF THE INVENTION

[0002] The invention relates to protective gloves, and more particularly, to three dimensional gloves that closely approximate the shape of a hand and include at least one performance-enhancing layer applied to an underlying glove shell.

BACKGROUND OF THE INVENTION

[0003] Protective gloves are used for a wide variety of household, industrial, and medical applications. Accordingly, gloves are made according to many different methods and from many different materials, depending on the intended application, the quantity to be produced, and the desired manufacturing cost.

[0004] There are four principle methods for manufacturing gloves. Some gloves are created by bonding flat sheets of elastomeric films and/or nonwoven materials to each other to form flat 2D gloves. Others are sewn from textile rolls and/or flat leather panels into 3D gloves that roughly approximate the shape of a hand. Still others, for example latex gloves, are formed by dipping hand shaped forms into elastomeric coating liquids, thereby forming elastomeric gloves that closely approximate the 3D shape of a hand. And yet others are knit by specialized glove knitting machines into 3D gloves that closely approximate to the shape of a hand. While 2D gloves and 3D gloves that only roughly approximate the shape of a hand are often cheaper to manufacture, the complex shape and movement of the hand favors the use of 3D gloves that closely approximate the true shape of a hand for comfort, grip, and dexterity.

[0005] It is sometimes desirable for a glove to include one or more materials that enhance its performance in one way or another. For example, it may be desirable to include an elastomeric material on the palm and inner finger surfaces, so as to increase friction in those areas and enhance the glove's gripping properties. Or it may be desirable to include a material such as para-aramid in the glove to increase its strength and cut resistance. The addition of other materials and/or fillers may be desired due to their resistance to penetration by sharp objects, such as rose thorns or hypodermic needles.

[0006] One approach is to prepare glove materials having the desired properties, possibly including filled and/or laminated layers, and then to manufacture the glove from the prepared materials. However, manufacturing a glove from such materials typically requires specialized equipment and methods, especially if the glove is to be formed into a shape that closely approximates the shape of a hand. The cost can be prohibitive, and the flexibility, thermal properties, and/or moisture vapor penetration properties of the resulting glove may be unacceptable. In addition, this approach typically requires that either half of the glove or the entire glove be manufactured from the specially prepared material, so that there is limited freedom to apply the enhancing materials only where they are needed on the glove. In addition, the prepared materials approach is not applicable to the fabrication of 3D knitted seamless glove shells, where the glove is knitted from yarn directly and there is no glove assembly.

[0007] For many applications, it is therefore desirable to add one or more performance-enhancing layers to a pre-manufactured glove shell. For example, a glove shell may be manufactured from cotton or from some other suitable material that is relatively easy to knit, dip, or otherwise form in an accurate 3D hand shape according to cost-effective methods well known in the art. A grip-enhancing layer and/or an anti-penetration layer can then be added to the palm and/or inner finger surfaces so as to enhance the grip and/or increase the protective qualities of the glove. By adding similar layers to the back of the shell, the entire glove can be covered by enhancing materials if so desired.

[0008] A performance-enhancing layer can be sewn to a glove shell, but this is a labor-intensive step, especially if the 3D shape of the shell is to be maintained. Another approach is to partially or fully dip the glove shell into a coating liquid, whereby the accurate 3D hand shape of the glove shell is preserved. In this approach, the basic dipping process used for making latex gloves is adapted slightly. The sewn or knit glove shell is mounted on a hand-shaped dipping form, and then the form and shell are dipped together so as to coat some or all of the glove shell surface with the enhancing material.

[0009] However, there are many limitations that apply to dipping as a method for applying performance-enhancing layers to a 3D glove shell. For example, dipping cannot be used to apply highly filler-loaded elastomers, textile layers or oriented films. Dipping also cannot be used to apply printed graphics to the glove. In addition, dipping tends to provide a relatively thick coating that significantly reduces the flexibility of the glove.

[0010] The limitations regarding filler-loaded elastomer layers applied by dipping can be understood as follows. Obviously, any coating material applied by dipping must be in a liquid state when the glove shell is dipped. The viscosity of the liquid coating material must be low enough to permit immersion of the form and glove shell in the coating material, and to permit excess coating material to flow away from the dipped shell by gravity and/or by acceleration of the dipping form. Blades and other types of coating control tooling are incompatible with dipping. As a result, dipping viscosities must typically be within a range of about 1-10K centipoise. This viscosity range precludes the use of highly concentrated or highly dense fillers, since either the viscosity of the coating material will be increased by the filler to an unacceptable level, or too much of the filler will settle in the dip tank and will not be applied to the glove.

[0011] U.S. Pat. No. 7,007,308, also by the present inventor, describes a method for applying performance-enhancing layers to the inner and/or outer surfaces of a glove, whereby a flat, solid layer of a material having the desired properties is attached to a glove shell by an adhesive, such as a thermoplastic. Use of an adhesive to attach the enhancing layer to the glove shell reduces the labor and manufacturing cost as compared to sewing. Use of an enhancing material that is prepared, cut, and preformed as a solid layer before it is applied to the glove shell allows the performance-enhancing material to include multiple layers of different substances, including fillers of any density. U.S. Pat. No. 7,007,308 teaches how to use this approach for flat, 2D glove shells. However, U.S. Pat. No. 7,007,308 is silent regarding adhesion of a solid, preformed enhancement layer to a glove shell having an accurate

3D hand shape. In addition, U.S. Pat. No. 70,073,808 is silent regarding features and methods that reduce the likelihood that edges of the applied enhancing layer will peel away from the shell.

[0012] What is needed, therefore, is a glove having a 3D shape that closely approximates the shape of a human hand, wherein the glove includes a performance-enhancing layer adhesively applied to a 3D hand-shaped knit or woven glove shell, and whereby the performance-enhancing layer includes at least one feature that cannot be provided by dipping of the glove shell in a coating material.

SUMMARY OF THE INVENTION

[0013] The present invention is a glove having a 3D shape that closely approximates the shape of a human hand, wherein the glove includes a performance-enhancing layer adhesively applied to a 3D hand-shaped knit or woven glove shell, and whereby the performance-enhancing layer includes at least one feature that cannot be provided by dipping of the glove shell in a coating material.

[0014] The method of the present invention includes preparing a solid, thin, flat, performance-enhancing layer, referred to herein as the "laminate preform," or simply as the "laminate." The laminate preform includes a laminating adhesive on one of its outer surfaces. The 3D glove shell is placed on a 3D laminating form that provides a smooth, wrinkle-free laminating surface. The laminate preform is then placed on the glove shell so that the layer of laminating adhesive is in contact with the laminating surface, and pressure is applied at an elevated temperature so as to adhesively attach the laminate layer to the glove shell.

[0015] In embodiments, the 3D laminating form includes opposing flat surfaces, and the laminating pressure is applied by a platen press, a roller press, or some other type of press that is designed to apply pressure to a substantially planar surface. In other embodiments, the laminating surface is curved or otherwise shaped, and the laminating pressure is applied by a bladder press or a vacuum bag press. This adhesion process can include all the typical process variables used in lamination, including heat, pressure and reactive adhesives. The lamination adhesive can include a thermoplastic, a pressure sensitive adhesive, and/or a reactive adhesive.

[0016] For measuring the flexibility benefits of the present invention, we have selected the ASTM D4032-08 standard test method for stiffness of fabric by the circular bend procedure. This test uses a standard 4"×8" test coupon. We have modified this method to use the palm and back of the gloves under test. After slitting the glove up one side and removing the fingers and thumb, the remaining coupon for an extra-large glove is very nearly 4 inches×8 inches. The circular bend test is sensitive to small changes in the glove and laminate system. In some cases we find that it is necessary to precondition the palm-back glove test coupons by multiple runs on the circular bend test to reach stable conditioned values. In the case of conditioned test values, we run the test 10 times and use the average of the results from tests 8, 9, and 10 as the stable, conditioned circular bend result.

[0017] Embodiments of the present invention include laminate preforms that are much thinner than can be achieved with dipping processes. In some embodiments, the thickness of the laminate preform is between 25 microns and 75 microns, which provides a low bending stiffness. Even in the embodiments where textile inserts and textile components are used in the laminate preforms, the circular bending stiffness is much lower than what can be provided by a dipped glove, and very much lower than what is found in gloves that include multiple layers of protective textile and dipped surfaces.

[0018] In embodiments, penetration of the lamination adhesive into the glove shell is controlled, since the stiffness of the glove tends to increase as more adhesive penetrates into the textile of the glove shell, and soft, flexible gloves are typically desired. The use of non-liquid thin film adhesives in embodiments of the present invention provides excellent adhesion and very controlled and limited penetration of the lamination adhesive into the textile shell. In embodiments, thin adhesive films of between 6 and 50 microns are used, so as to provide only limited penetration of the adhesive into the fibers of the glove shell. This approach is combined in some embodiments with thin laminate preforms to maximize the circular bending performance.

[0019] In various embodiments, the glove shell is reversibly deformable, whereby it is deformed while it is on the 3D laminating form and then returns to its accurate 3D hand-shape after the laminate preform is applied and the resulting glove is removed from the form.

[0020] In embodiments, the performance-enhancing feature provided by the laminate that cannot be provided by dipping is an oriented film, a highly filler-loaded elastomer, a fabric layer, and/or printed graphics. In some embodiments, preparation of the laminate preform includes printing, roll to roll coating, extrusion, stenting, blown extrusion, weaving, and/or knitting.

[0021] As discussed above, a primary method in the prior art for applying coating layers to gloves is dipping. Gloves are dipped for a number of reasons. The most important are:

[0022] Coatings create a barrier film on the glove that protects the wearer

[0023] Coatings have higher coefficients of friction than textiles, so they improve the grip of the glove

[0024] Coatings have higher abrasion resistance than textiles and improve the durability of the glove.

[0025] In embodiments, the laminate preforms of the present invention offer the same benefits. However, the materials and processing options enabled by the present invention can deliver these benefits with much lower impact on the stiffness of the glove.

[0026] Note that the present invention is highly suitable for combination with the teachings of U.S. Pat. No. 7,007,308, also by the present inventor.

[0027] One general aspect of the present invention is a glove having a three-dimensional shape that approximates the shape of a human hand. The glove includes a knit or woven glove shell having a three-dimensional shape that approximates the shape of a human hand, the glove shell having an interior surface and an exterior surface, and a laminate preform bonded by a lamination adhesive layer to a portion of the exterior surface of the glove shell, the laminate preform including an enhancement feature that cannot be provided by dipping the glove shell into a liquid coating material.

[0028] In embodiments, the enhancement feature is a textile layer, an oriented film, a layer of graphics, an elastomeric layer including a filler having a density that would cause the filler to settle if added to the liquid coating material, or an elastomeric layer including a filler having a density that, if added to the liquid coating material, would increase a viscosity of the liquid coating material, thereby rendering the liquid coating material unsuitable for dip-coating the glove shell.

[0029] In some embodiments, the enhancement feature is an elastomeric layer including a filler having a density of between 2 and 14. In other embodiments, the laminate preform includes a grip layer on an outer surface thereof. In certain embodiments, the lamination adhesive layer has a surface energy greater than 30 mJ/m^2. And in various embodiments the lamination adhesive layer includes at least one of a thermoplastic, a pressure sensitive adhesive, and a reactive adhesive.

[0030] In some embodiments, the lamination adhesive layer is one of SBR and urethane. In other embodiments the lamination adhesive layer is a film having a thickness of between 6 microns and 50 microns.

[0031] In various embodiments the bonding of the laminate preform to the glove shell is such that a **1** inch ASTM T peel sample having the same bonding properties would have a **5** average peak peel forces of greater than 5 lbf/inch.

[0032] In certain embodiments, the glove shell is knit or woven from a textile having a total surface energy of greater than 40 mJ/m^2. In some embodiments, the glove shell is knit or woven from one of cotton and nylon.

[0033] In embodiments, the laminate preform includes an exposed upper layer, whereby the upper layer and the lamination adhesive layer extend beyond any intervening layers so that the perimeter of the upper layer is bonded by the lamination adhesive layer directly to the glove shell. In some of these embodiments the upper layer is a thermoplastic urethane, and the glove shell is knit or woven from nylon. In other of these embodiments the upper layer is an elastomeric film of greater than 100% elongation.

[0034] Various embodiments further include an inner laminate preform bonded to an inner surface of the glove shell. And some embodiments further include an inner cut-and-sew glove lining.

[0035] Another general aspect of the present invention is a method of manufacturing a glove having a three-dimensional shape approximating the shape of a human hand, the glove including a laminate preform attached by a lamination adhesive to a portion of an underlying glove shell. The method includes providing a glove shell having a three-dimensional shape that approximates the shape of a human hand, preparing a flat, solid laminate preform, the laminate preform including an exposed layer of lamination adhesive, providing a three dimensional laminating form having a hand-shaped region, the hand-shaped region including a smooth laminating surface, placing the glove shell on the laminating form so that the glove shell surrounds the hand-shaped region, and so that a portion of the glove shell conforms closely to the laminating surface without any seam or wrinkle, placing the laminate preform on the glove shell above the laminating surface, the exposed layer of lamination adhesive being in direct contact with the glove shell, applying a pressure above ambient pressure at a temperature above ambient temperature to the assembled laminate preform, glove shell, and laminating form, thereby causing the lamination adhesive to bond the laminate preform to the glove shell, and removing the glove shell with the laminate preform bonded thereto from the laminating form.

[0036] In embodiments, the hand-shaped region of the laminating form includes a pair of opposing areas that are overlapping, substantially flat, and substantially parallel to each other, the laminating surface being included in one of the opposing areas.

[0037] In some embodiments applying pressure to the assembled lamination preform, glove shell, and laminating form includes applying pressure using at least one of a platen press, a roll press, a belt press, and a nip roll press.

[0038] In various embodiments the laminating surface is a non-flat, smooth surface. And in some of these embodiments applying pressure to the assembled lamination preform, glove shell, and laminating form includes applying pressure using at least one of a bladder press and a vacuum bag press.

[0039] In some embodiments, the glove shell is reversibly deformable, placing the glove shell on the laminating form includes deforming the glove shell, and removing the glove shell with the laminate preform bonded thereto from the laminating form includes allowing the glove shell with laminate preform bonded thereto to recover substantially to the pre-deformation shape of the glove shell.

[0040] In some of these embodiments, the shape recovery of the glove shell is disproportionately located in regions of the glove shell to which the laminate preform is not bonded, thereby causing a warping deformation of the laminate preform. In other of these embodiments placing the glove shell on the laminating form includes increasing the circumferences of the glove shell fingers by a factor of between 10% and 60%.

[0041] Various embodiments further include, before placing the lamination preform on the glove shell, removing substantially all spin finish and lubricants from the portion of the glove shell that conforms closely to the laminating surface, such that a Soxhlet extraction with acetone yields less than 1.5% by weight of the textile.

[0042] Certain embodiments further include, before placing the lamination preform on the glove shell, removing substantially all spin finish and lubricants from the portion of the glove shell that conforms closely to the laminating surface, such that a Soxhlet extraction with acetone yields less than 0.5% by weight of the textile.

[0043] In some embodiments the laminate preform includes at least one of a textile layer, an oriented film, a layer of graphics, a filler having a density that would cause the filler to settle if added to the liquid coating material, and a filler having a density that, if added to the liquid coating material, would increase a viscosity of the liquid coating material, thereby rendering the liquid coating material unsuitable for dip-coating the glove shell.

[0044] In other embodiments preparing the flat, solid laminate preform includes at least one of printing, roll to roll coating, extrusion, stenting, blown extrusion, weaving, and knitting.

[0045] In certain embodiments, the pressure above ambient pressure is between 5 psi and 150 psi above ambient pressure. And in various embodiments the temperature above ambient temperature is between 200 degrees Fahrenheit and 375 degrees Fahrenheit.

[0046] Some embodiments further include preparing a flat, solid inner laminate preform, the inner laminate preform including an exposed layer of inner lamination adhesive and placing the inner laminate preform on the laminating form before placing the glove shell on the laminating form, so that the inner lamination adhesive is in direct contact with the inner surface of the glove shell, where applying pressure to the assembled laminate preform, glove shell, inner laminate preform, and laminating form causes the inner lamination adhesive to bond the inner laminate preform to the inner surface of the glove shell.

[0047] And other embodiments further include attaching a cut-and-sew inner liner inside of the glove shell before placing the inner lining and glove shell on the laminating form.

[0048] The features and advantages described herein are not all-inclusive and, in particular, many additional features and advantages will be apparent to one of ordinary skill in the art in view of the drawings, specification, and claims. Moreover, it should be noted that the language used in the specification has been principally selected for readability and instructional purposes, and not to limit the scope of the inventive subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0049] FIG. **1**A is a front perspective view of a laminating form and a laminate preform before assembly;

[0050] FIG. **1**B is a front perspective view of a laminating form, a glove shell, and a laminate preform assembled in preparation for lamination;

[0051] FIG. **1**C is a cross sectional view of FIG. **1**B taken through the finger region;

[0052] FIG. **1**D is a cross sectional view of FIG. **1**B taken through the palm region;

[0053] FIG. **2**A is a cross sectional view similar to FIG. **1**D, but of an embodiment wherein the laminate preform includes a graphics layer between an outer layer and an adhesive layer;

[0054] FIG. **2**B is a front view of an embodiment similar to FIG. **2**A, showing a graphics layer visible below a transparent outer layer;

[0055] FIG. **3** is a cross sectional view similar to FIG. **2**, but of an embodiment wherein the laminate preform includes an oriented film between an outer layer and an adhesive layer, the outer layer and adhesive layers being extended beyond the film layer so that the circumference of the outer layer is bonded directly to the glove shell;

[0056] FIG. **4** is a cross sectional view similar to FIG. **3**, but of an embodiment wherein the laminate preform includes a fabric layer between the outer layer and the adhesive layer;

[0057] FIG. **5** is a cross sectional view similar to FIG. **4**, but of an embodiment wherein the laminate preform includes both a fabric layer and a filled elastomer layer between the outer layer and the adhesive layer;

[0058] FIG. **6** is a cross sectional view similar to FIG. **3**, but of an embodiment that also includes an inner laminate preform bonded to an inner surface of the glove shell;

[0059] FIG. **7** is a cross sectional view similar to FIG. **3**, but of an embodiment that also includes a cut-and-sew liner attached within the glove shell;

[0060] FIG. **8**A is a cross-sectional view similar to FIG. **1**C, except that the glove shell fingers are reversibly deformed by the fingers of the laminating form;

[0061] FIG. **8**B is a cross sectional view of the glove fingers of FIG. **8**A after having been removed from the laminating form and having recovered from deformation;

[0062] FIG. **9** is a cross sectional view of the embodiment of FIG. **1**C being laminated in a platen press;

[0063] FIG. **10** is a cross sectional view of an embodiment similar to the embodiment of FIG. **1**C but wherein the laminate preform extends to the sides of the glove shell fingers, the embodiment being laminated in a bladder press;

[0064] FIG. **11**A is a bar graph comparing a knit glove with no applied enhancement layer with a knit glove to which a TPU laminate preform has been applied, and demonstrating that the knit glove with laminate preform is 72% softer than a knit glove that has been palm dipped;

[0065] FIG. **11**B is a bar graph showing that a knit glove with a TPU and textile laminate preform applied to the palm is 48% softer than a knit glove that has been palm-dipped with PVC only;

[0066] FIG. **11**C is a bar graph showing that a knit glove with a para-aramid textile and urethane laminate preform applied to the palm is 54% softer than a para-aramid knit glove that has been palm dipped with only nitrile;

[0067] FIG. **11**D is a bar graph showing that a knit glove with a TPU laminate preform and including a textile insert is 82% softer than a knit glove that has been nitrile dipped; and

[0068] FIG. **11**E is a bar graph showing that a knit glove with a TPU laminate preform applied to the palm and including a **2** ply textile insert is 98% softer than a knit glove with a latex palm dip and a **3**-ply textile insert.

DETAILED DESCRIPTION

[0069] The present invention is a glove having a 3D shape that closely approximates the shape of a human hand, wherein the glove includes a performance-enhancing layer adhesively applied to a 3D hand-shaped knit or woven glove shell, and whereby the performance-enhancing layer includes at least one feature that cannot be provided by dipping of the glove shell in a coating material.

[0070] With reference to FIGS. **1**A and **1**B, the method of the present invention includes preparing and assembling one or more solid, flat, performance-enhancing layers **100**, referred to herein collectively as the “laminate preform,” or simply as the “laminate.” The knit or woven 3D glove shell **102** is placed on a 3D laminating form **104** that provides at least one smooth, wrinkle-free laminating surface **106**, and the laminate preform **100** is then placed in contact with the laminating surface **106**.

[0071] With reference to FIGS. **1**C and **1**D, which are cross-sectional views as indicated in FIG. **1**B, a non-liquid, thin film laminating adhesive **108** is included between the laminate preform **100** and the glove shell (and in some embodiments also between layers of the laminate preform). In embodiments, the laminate adhesive **108** is a solid at ambient pressure and temperature, and is included at least on one of the outward-facing surfaces of the laminate preform **100**.

[0072] Pressure is then applied to the assembled laminating form **104**, glove shell **102**, and laminate preform **100** at an elevated temperature, so as to adhesively bond the laminate preform **100** to the glove shell **102**.

[0073] Of course, because there are no sewing attachments between the laminate preform **100** and the glove shell **102**, as is typical in glove assemblies of the prior art, it is important that the laminate preform **100** be well bonded to the glove shell **102**, since poor bonding could result in premature product failure. Two factors are critical to the quality of the bond between the laminate preform **100** and the glove shell **102**. First, the surface of the glove shell fiber must be free of spin finish and lubricants that are used in production of yarns and textiles. A suitable scouring process is generally required, and the Soxhlet extraction with acetone must be below 1.5% by weight of the textile, with a more preferred value of 0.5% for best durability of the bond.

[0074] The second factor that is critical to the quality of the bond is the surface match of the glove shell fiber and the lamination adhesive **108**. Both surface energies must be high enough to make wetting and long term bonding thermodynamically favorable. In embodiments, the glove shell textile has a total surface energy of greater than 40 mJ/m^2. Cotton and nylon meet these criteria, whereas PET fiber does not without a modifying treatment or coating. In embodiments, the adhesive surface energy is greater than 30 mJ/m^2. SBR and urethane adhesives meet this surface energy requirement. These examples are not intended to be exhaustive, and many fiber and adhesive combinations can provide the adhesion performance required by this invention. In wear trials, it has been found that a laminate preform bonded to the glove shell tested using ASTM D1876-08 standard test method for peel resistance of adhesives (T-Peel Test) with a **1**" wide peel sample that has 5 average peak peel forces of greater than 5 lbf/inch will meet the requirements of this invention for durability.

[0075] The bonding of the laminate preform **100** to the glove shell **102** can use any of various adhesive processes. Thermoplastic, pressure-sensitive, and reactive adhesives are all effective. In embodiments, penetration of the lamination adhesive **100** into the glove shell **102** is controlled, since the stiffness of the glove shell **102** tends to increase as more adhesive penetrates into the textile of the glove shell **102**, and soft, flexible glove shells **102** are typically desired. The use of non-liquid thin film adhesives **108** in the present invention provides excellent laminate adhesion and very controlled and limited penetration of the lamination adhesive **108** into the textile of the glove shell **102**. In embodiments, thin adhesive films **108** of between 6 and 50 microns are used, so as to provide only limited penetration of the adhesive **108** into the fibers of the glove shell **102**.

[0076] A key aspect of the present invention is the capacity to combine glove shells **102** having accurate hand-shapes with solid laminate preforms **100** that include features which cannot be provided by glove shell dipping methods. Printed graphics, high filler loaded elastomers, textile layers, and oriented films are all important examples of materials and features that can only be included in the enhancing layer if the enhancing layer is prepared ahead of time as a solid, flat laminate preform **100**. This approach allows such features to be added to the flat, solid laminate preform **100** by using such methods as printing, roll to roll coating, gravure coating, extrusion, stenting, blown extrusion, weaving, and/or knitting, before the laminate preform **100** is laminated onto the glove shell **102**. It is important to note that, in embodiments, the laminate preform production methods have very tight control of materials properties and tight control of the preform thickness. In some embodiments the thicknesses of the adhesive and other film layers are controlled to less than +/−5 microns.

[0077] In the embodiment of FIGS. **1**A-**1**D, the laminate preform **100** is a single layer of elastomeric film **110** combined with a thermoplastic adhesive **108**. In the embodiment of FIGS. **2**A and **2**B, the laminate preform **100** includes a graphics layer (fusable ink) **200** included between a grip layer (thermoplastic urethane, "TPU") **202** and the adhesive layer **108**. The ability to include such graphical layers in the laminate preform **100** provides opportunities for durable labeling and branding that cannot be obtained when enhancement layers are applied by dipping. Of course, graphics can always be applied to the surface of a finished glove, but then the graphics will not be embedded within nor protected by by the performance-enhancing layer.

[0078] In various embodiments, a digital inkjet, a screen printing, or a web press printing process is used to form a graphics layer **200** on top of the adhesive layer **108**. In a second laminate preforming step, the graphics layer **200** is protected with an abrasion layer **202** laminated over the print layer. This three ply laminate preform **100** is then applied to the glove shell **102** by thermoplastic bonding of the adhesive layer **108** during the lamination step. Because the graphics layer is built on a smooth polymeric or elastomeric film, fine detail and print quality are preserved. This fine print detail is not possible when printing directly on the surface of a textile or on a dipped textile surface.

[0079] As discussed above, the adhesive strength and quality of the bond between the laminate preform **100** and the glove shell **102** is one important factor in preventing failure of the bond and maintaining the integrity of the laminated glove. Another important factor is the edge condition of the bond between the laminate preform **100** and the glove shell **102**. It can be shown that the peel resistance of an elastic film is higher than the peel resistance of a high modulus film when bonded at the same specific adhesive strength. The reason for this is that an elastic film stretches and spreads the stress at the peel point, whereas a hard film cannot stretch and deform. As a result, a peel crack is propagated at lower loads for hard films.

[0080] Embodiments in which thermoplastic urethane ("TPU") film is bonded to a nylon glove shell **102** provide excellent results in this regard, because the TPU is low modulus (400-500% elongation at break), and the nylon is also low modulus for fiber (30% elongation at break). Even in embodiments where the glove shell **102** has a high modulus, use of a low modulus laminate preform **100** provides better peel resistance as compared to a high modulus laminate preform **100**. In various embodiments, elastomeric films of greater than 100% elongation are included in the laminate preform **100**.

[0081] With reference to FIGS. **3** and **4**, in certain embodiments where a top layer **202** of a multi-layer laminate preform **100** has a low modulus, but one or more layers below the top layer have a high modulus, the edge of the laminate preform is "stepped" by extending the top layer **202** beyond the lower layers, so that the top layer **202** is directly bonded to the glove shell **202**. This approach provides a high peel condition at the edge of the laminate preform **100**, even when stiff layers are included in the central region of the laminate preform **100**.

[0082] In the embodiment of FIG. **3**, a high modulus oriented film **300** is included between the grip layer **202** and the adhesive layer **108**, and in FIG. **4** a high modulus textile layer **400** is included between the grip layer **202** and the adhesive layer **108**.

[0083] FIG. **5** is similar to FIG. **4** except that a filled polymer layer **500** is included beneath the textile layer **400**. In Example #3 described below, 600-50 grit **5** silicon carbide grain is used as a filler in one of the prefabricated elastomer layers. In various embodiments, ceramic and/or metallic fillers are included which have specific gravities of between 2 and 14. Fillers having such high densities would segregate in a low viscosity coating, such as a coating applied by dipping. However blade coating and extrusion are very effective for production of films with dense fillers that can be included in the laminate preform. In one example, Styrene Butadiene rubber elastomer was dissolved in solvent and a ceramic grain was mixed in at **10**K centipoise. This mix **500** was coated to a film using a knife over roll process. In a similar example, a **200** and **660** grit coating having a viscosity of between 2500 and 5000 cps was applied to a chloroprene film as part of a laminate preform **100**. Many other powdered, fibrous, and platelet type fillers are included in embodiments of the present invention to impart valuable permeability, cut, abrasion, flame, heat, and other properties to the laminate preform **100**, where such fillers at their required loadings result in excessive viscosity that would prevent them from being used in a dip coating process.

[0084] With reference to FIG. **6**, embodiments of the present invention include a second laminate preform **600** that is laminated to the inner surface of the glove shell **102**. In the embodiment of FIG. **6**, a layer **600** that mechanically resists cuts and punctures is placed between the 3D laminating form **104** and the glove shell **102**, so that it is laminated to the inner surface of the glove shell **102**. The outer laminate preform includes an oriented polymer film **300** between a TPU grip layer **202** and an adhesive layer **108**.

[0085] With reference to FIG. **7**, in various embodiments a cut-and-sew liner **700** is attached inside of the glove shell **102**, and is included with the glove shell **102** on the 3D laminating form **104**. The resulting glove includes the cut-and-sew liner in its interior and the laminate preform on its exterior surface, with the knit or woven glove shell **102** in between.

[0086] With reference to FIG. **8**A, in various embodiments, the glove shell **102** is reversibly deformable, whereby its shape is deformed while it is mounted on the 3D laminating form **104**. In embodiments, this is helpful in providing the smooth, crease-free area that is required for lamination. FIG. **8**A is a cross-sectional illustration of such an embodiment taken through the finger region. With reference to FIG. **8**B, the glove shell fingers return to their accurate, rounded 3D finger-shapes after the laminate preform **100** is applied thereto and the resulting glove is removed from the 3D laminating form **104**.

[0087] In various embodiments the laminate preform is designed to work with the 3D laminating form **104** to increase the wrap of the laminate preform **100** around portions of the hand. As illustrated in FIG. **8**A, the 3D laminating form **104** can elongate the fingers of the glove shell **102** to increase the size of the flat bonding face **106**. The resulting warp of the laminate preform **100** is thereby increased after the glove shell **102** is removed from the 3D laminating form **104** and returns to its 3D hand-shape.

[0088] An important aspect of some embodiments of the invention is the way in which the glove shell **102** contracts after it is removed from the 3D lamination form **104**. In embodiments, the glove shell fingers are elongated in their circumference by between 10 and 60% when the glove shell **102** is on the 3D laminating form **104**. This increases the surface area of the glove shell fingers that is wrinkle free and monotonic in surface curvature (fully flat is not required), and is thereby available for bonding of the laminate preform thereto. After the lamination step, the 3D laminating form **104** is removed and the glove shell **102** can recover its shape. The laminated area tends not to recover, but instead tends to retain its laminated width.

[0089] In some of these embodiments a laminate preform **100** is not applied to the backs of the finger and hand regions of the glove shell, so that most of the shape recovery takes place in these unlaminated regions. The result is that after the glove is removed from the 3D laminating form **104**, a higher percentage of the finished finger circumference is covered by the laminate preform **100** than was covered when the glove was on the 3D laminating preform. If the ratio of width to thickness on the 3D laminating preform **104** is 10:1 for example, then 40% of the elongated circumference is readily bonded to the laminate perform **100**, and the ratio of back of hand and sides to laminate width is approximately 4:6. However, after removal from the 3D laminating form **104**, if the back of hand and sides contract by 50%, the laminated length will have a ratio to the back and sides of 4:3, significantly increasing the coverage of the laminate preform **100** in the relaxed glove.

[0090] In the embodiments of FIGS. **1**A through **8**B, the 3D laminating form **104** includes opposing flat surfaces **106**, and the lamination pressure can be applied by a press such as a platen press that is designed to apply pressure to a substantially flat surface. This is illustrated in FIG. **9**, where a cross section of the finger regions illustrated in FIG. **1**C are shown as being pressed at an elevated temperature between a pair of hot press platens **900**, **902**. In embodiments, the lamination temperatures range from 200 degrees Fahrenheit to 375 degrees Fahrenheit for bonding of the laminate preform **100** to the glove shell **102**, and the applied lamination pressures range from 5 psi to 150 psi. The layer **904** shown between the upper platen **900** and the glove is a conforming layer that is made from a heat resistant elastomer and improves the uniformity of contact between the glove and the press platen face.

[0091] While FIG. **9** is illustrated as a vertical platen press, in similar embodiments a roll press, a belt press, and/or a nip roll press is used to laminate the laminate preform **100** to the glove shell **102**.

[0092] In other embodiments, the laminating surface **106** of the 3D laminating form **104** is curved or otherwise shaped, although it is always smooth and free of creases. In embodiments where increased wrap-around of the laminate preform **100** on the glove shell **102** is desired, and/or where the laminating surface **106** is not flat, bladder presses and vacuum bag techniques are used to apply the laminating pressure. With reference to FIG. **10**, the conformability of the bladder or vacuum bag **1000** permits the laminate preform **100** to wrap around the fingertips and fourchette area of the glove shell. FIG. **10** illustrates an embodiment where the laminate preforms **100** extend to the sides of the glove shell fingers **104**, and a bladder **1000** is forced either pneumatically or hydraulically against the tops and sides of the glove shell fingers, thereby laminating the fingers on three sides. By using two laminate preforms **100**, this approach can provide complete coverage of the glove shell **102**. In the same way, a bladder press or a vacuum bag press can be used to apply laminating pressure to a laminate preform **100** that is placed against a smooth, curved surface **106** such as the palm of an accurately hand-shaped 3D laminating form **104**.

[0093] One of the benefits of the present invention in various embodiments is the thinness of the laminate preform that can be provided, and the resulting flexibility of the glove. For measuring these benefits, we have selected the ASTM D4032-08 standard test method for stiffness of fabric by the circular bend procedure. This test uses a standard 4"×8" test coupon. We have modified this method to use the palm and back of the gloves under test. After slitting the glove up one side and removing the fingers and thumb, the remaining coupon for an extra-large glove is very nearly 4 inches×8 inches. The circular bend test is sensitive to small changes in the glove and laminate system. In some cases, we find that it is necessary to precondition the palm-back glove test coupons by multiple runs on the circular bend test to reach stable conditioned values. In the case of conditioned test values, we run the test 10 times and use the average of the results from tests 8, 9, and 10 as the stable conditioned circular bend result.

[0094] Embodiments of the present invention include laminate preforms that are much thinner than can be achieved with dipping processes. In some embodiments, the thickness of the laminate preform is between 25 microns and 75 microns, which provides a low bending stiffness. Even in embodiments where textile inserts and textile components are used in the laminate preforms, the circular bending stiffness is much lower than what can be provided by dipped gloves, and very much lower than what is found in gloves that include multiple layers of protective textile and dipped surfaces.

[0095] FIG. **11**A is a bar graph comparing a knit glove with no applied enhancement layer with a knit glove to which a TPU laminate preform has been applied, and demonstrating that the knit glove with laminate preform is 72% softer than a knit glove that has been palm dipped. The first values in the graph are the thickness and bending stiffness of a 13 g 210 Denier nylon glove shell at approximately 400 g of bending stiffness. The next set of values refers to the same shell after application thereto of a **3** ply 60 micron laminate of TPU with a graphics layer. As can be seen from the data, the lamination process reduces the thickness of the knit, resulting in a slightly thinner glove even with the addition of the laminate preform. The third set of data refers to a directly comparable palm-coated dipped glove with a typical dipping thickness of 300-350 microns. As can be seen from the graph, the lamination process produces a glove that is almost as soft as the uncoated knit at **410** vs 440 grams, and the invention results in gloves with less than ⅓ of the stiffness of comparable dipped gloves.

[0096] FIG. **11**B presents a flexibility comparison using the circular bending test described above, showing that a knit glove with a TPU and textile laminate preform applied to the palm is 48% softer than a knit glove that has been palm-dipped with PVC only. FIG. **11**C presents a similar flexibility comparison, showing that a knit glove with a para-aramid textile and urethane laminate preform applied to the palm is 54% softer than a para-aramid knit glove that has been palm dipped with only nitrile. FIG. **11**D presents a similar flexibility comparison, showing that a knit glove with a TPU laminate preform and including a textile insert is 82% softer than a knit glove that has been nitrile dipped. And FIG. **11**E presents a similar flexibility comparison, showing that a knit glove with a TPU laminate preform applied to the palm and including a **2** ply textile insert is 98% softer than a knit glove with a latex palm dip and a **3**-ply textile insert.

EXAMPLES

Example 1

Knit Shell with Insert and Laminate Preform Including Grip And Graphics Layers

[0097] Glove shell: 210 denier nylon 13 gauge knit shell

[0098] Insert: 220 denier of construction 100×60 epi of PET fiber woven or 30 denier Nylon at 100×100 epi bonded inside the shell

[0099] Laminate preform:

[0100] Grip layer: polyether thermoplastic urethane ("TPU") of hardness 80 shore of 25 microns thickness

[0101] CYK graphics layer: fusible inks of 5-12 microns thickness

[0102] Adhesive Layer: polyether thermoplastic urethane adhesive layer, 25 micron thick, that bonds the graphics layer and grip layer to the glove shell at 350 degrees Fahrenheit

[0103] Manufacturing Process: The adhesive layer is printed with the graphics layer, then the grip layer is laminated on top of the other two layers to complete the 3-ply laminate preform material. The 210 denier knit shell is mounted on the 3D laminating form. The laminate preform material is cut to shape and laminated to the glove shell on the 3D laminating form in a platen press at 350 F.

Example 2

Knit Shell with TPU/Grain-Elastomer/30 Denier Nylon Woven/PSA Laminate Preform

[0104] Glove shell: 210 denier nylon 13 gauge knit shell

[0105] Insert: 220 denier 100×60 epi of PET fiber woven or 30 denier nylon at 100×100 epi bonded inside the glove shell

[0106] Laminate preform:

[0107] Grip layer: Polyether thermoplastic urethane of hardness 85 shore of 25 microns thickness

[0108] CYK graphics layer: fusible inks of 5-12 microns thickness

[0109] Adhesive tie layer: Polyether thermoplastic urethane adhesive between 12 and 25 microns thick

[0110] Mechanical layer: 30 denier woven nylon 100×100 epi

[0111] Filler layer: SB rubber in solvent with 220+600 grit silicone carbide filler added in a 4.5:1 ratio to the elastomer by weight

[0112] Adhesive: Rosinated SBR blend in a solvent-based pressure sensitive adhesive (PSA)

[0113] Manufacturing process: The grip layer is printed with the graphics layer. Then the grip layer is laminated to the textile layer. The textile layer has TPU on the face side and the grain layer and PSA blade coated to the reverse side. This completes the 6 ply laminate preform material. The 210 denier knit shell is mounted on the 3D laminating form. The laminate preform material is cut to shape and laminated to the glove shell on the 3D laminating form in a platen press at 300 degrees Fahrenheit.

Example 3

Knit Shell with Non-Thermoplastic PU/Grain-Elastomer-PSA Laminate Preform

[0114] Glove shell: 210 denier nylon 13 gage knit shell

[0115] Insert: 220 denier of construction 100×60 epi of PET fiber woven or 140 denier 80×70 para-aramid woven or 30d Nylon at 100×100 epi bonded inside the shell

[0116] Laminate preform:

[0117] Grip layer: Cast non-thermoplastic polyester urethane of hardness 95 shore of 25 microns thickness

[0118] CYK graphics layer: fusible inks of 5-12 microns thickness

[0119] Filler layer: SB rubber in solvent with 220+600 grit silicone carbide filler added at a 4.5:1 ratio to the elastomer by weight

[0120] Adhesive: Rosinated SBR blend in solvent-based pressure sensitive adhesive (PSA)

[0121] Manufacturing process: The grip layer is cast from a reactive mixture of polyol and isocyanate, cured, and then printed with the graphics layer. Then the grain layer and PSA layers are roll-coated to the glove shell side of the laminate preform. This completes the 4-ply laminate preform material. The **210** denier knit glove shell is mounted on the 3D laminating form. The laminate perform material is cut to shape and laminated to the glove shell on the 3D laminating form in a platen press at 300 Fahrenheit.

Example 4

Knit Shell with Neoprene/Nylon/PSA Laminated Preform

Example 5

Knit Shell Over a Glove with Unbonded or Semi Bonded Insert Glove

[0122] Glove shell: 210 denier nylon 13 gage knit shell

[0123] Insert: Cut-and-sew liner of 200 denier×400 denier para-aramid of 110×65 epi of construction woven, bonded inside the glove shell

[0124] Laminate preform:

[0125] Grip layer: Polyester thermoplastic urethane of hardness 85 shore 25 microns thick

[0126] CYK graphics layer: fusible inks of 5-12 microns thickness

[0127] Adhesive tie layer: Polyester thermoplastic urethane adhesive 25 microns thick

[0128] Manufacturing process: The grip layer is printed with the graphics layer, then the grip layer is laminated to the adhesive layer. This complete the 3-ply laminate preform. The 210 denier knit glove shell is mounted on the 3D laminating form. The laminate preform material is cut to shape and laminated in a platen press at 350 degrees Fahrenheit to the glove shell on the 3D laminating form. After removal from the 3D laminating form the glove shell is bonded to the sewn liner.

Example 6

Cut and Sew Shell with TPU/Inkjet/TPU Laminate Preform

[0129] Shell: 100 denier nylon 50 gage knit with 10% 70 denier lycra in a full fourchette cut-and-sew shell

[0130] Insert: 220 denier of construction 100×60 epi of PET fiber woven or 30 denier Nylon at 100×100 epi, bonded inside the glove shell

[0131] Laminate preform:

[0132] Grip layer: Polyester thermoplastic urethane of hardness 85 shore 25 microns thick

[0133] CYK graphics layer: fusible inks 5-12 microns thick

[0134] Adhesive: Polyester thermoplastic urethane adhesive layer that bonds the graphics layer and grip layer to the glove shell at 350 degrees Fahrenheit

[0135] Manufacturing Process: The adhesive layer is printed with the graphics layer, then the grip layer is laminated to the other two layers to complete the 3-ply laminate preform material. The 210 denier knit shell is mounted on the 3D laminating form. The laminate preform material is cut to shape and bonded to the glove shell on the 3D laminating form in a platen press at 350 degrees Fahrenheit.

Example 7

Vacuum or Bladder Press Formed Laminate Preform

Example 8

Double Sided Laminate Preform on Palm and Back Surfaces Of the Glove Shell, with Overlaps at the Finger Tips and the Fourchettes (See FIG. **7**)

[0136] Shell: 210 denier nylon 13 gage knit shell

[0137] Insert: Full cut and sew glove of a suitable fabric having a 220 denier construction 100×60 epi of PET fiber woven, or 30 denier Nylon at 100×100 epi, or 200 denier×400 denier 110×65 epi para-aramid bonded inside the glove shell

[0138] Laminate preform:

[0139] Grip layer: Polyester thermoplastic urethane of hardness 85 shore of 25 microns thickness

[0140] CYK graphics layer: fusible inks of 5-12 microns thickness

[0141] Adhesive layer: Polyester thermoplastic urethane adhesive layer that bonds the graphics layer and grip layer to the glove shell at 350 degrees Fahrenheit

[0142] Manufacturing process: The adhesive layer is printed with the graphics layer, then the grip layer is laminated to the other two layers to complete the 3-ply laminate preform material. The 210 denier knit shell is mounted on the 3D laminating form. The laminate preform material is cut to shape and laminated to the glove shell on the 3D laminating form in a platen press at 350 degrees Fahrenheit. Then the assembled knit shell and laminate preform are bonded to the cut-and-sew insert glove.

[0143] The foregoing description of the embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of this disclosure. It is intended that the scope of the invention be limited not by this detailed description, but rather by the claims appended hereto.

What is claimed is:

1. A glove having a three-dimensional shape that approximates the shape of a human hand, the glove comprising:

a knit or woven glove shell having a three-dimensional shape that approximates the shape of a human hand, the glove shell having an interior surface and an exterior surface; and

a laminate preform bonded by a lamination adhesive layer to a portion of the exterior surface of the glove shell, the laminate preform including an enhancement feature that cannot be provided by dipping the glove shell into a liquid coating material.

2. The glove of claim **1**, wherein the enhancement feature is one of:

a textile layer;

an oriented film;

a layer of graphics;

an elastomeric layer including a filler having a density that would cause the filler to settle if added to the liquid coating material; and

an elastomeric layer including a filler having a density that, if added to the liquid coating material, would increase a viscosity of the liquid coating material, thereby rendering the liquid coating material unsuitable for dip-coating the glove shell.

3. The glove of claim **1**, wherein the enhancement feature is an elastomeric layer including a filler having a density of between 2 and 14.

4. The glove of claim **1**, wherein the laminate preform includes a grip layer on an outer surface thereof.

5. The glove of claim **1**, wherein the lamination adhesive layer has a surface energy greater than 30 mJ/m^2.

6. The glove of claim **1**, wherein the lamination adhesive layer includes at least one of a thermoplastic, a pressure sensitive adhesive, and a reactive adhesive.

7. The glove of claim **1**, wherein the lamination adhesive layer is one of SBR and urethane.

8. The glove of claim **1**, wherein the lamination adhesive layer is a film having a thickness of between 6 microns and 50 microns.

9. The glove of claim **1**, wherein the bonding of the laminate preform to the glove shell is such that a **1** inch ASTM T peel sample having the same bonding properties would have a **5** average peak peel forces of greater than 5 lbf/inch.

10. The glove of claim **1**, wherein the glove shell is knit or woven from a textile having a total surface energy of greater than 40 mJ/m^2.

11. The glove of claim **1**, wherein the glove shell is knit or woven from one of cotton and nylon.

12. The glove of claim **1**, wherein the laminate preform includes an exposed upper layer, whereby the upper layer and the lamination adhesive layer extend beyond any intervening layers, so that the perimeter of the upper layer is bonded by the lamination adhesive layer directly to the glove shell.

13. The glove of claim **12**, wherein the upper layer is a thermoplastic urethane, and the glove shell is knit or woven from nylon.

14. The glove of claim **12**, wherein the upper layer is an elastomeric film of greater than 100% elongation.

15. The glove of claim **1**, further comprising an inner laminate preform bonded to an inner surface of the glove shell.

16. The glove of claim **1**, further comprising an inner cut-and-sew glove lining.

17. A method of manufacturing a glove having a three-dimensional shape approximating the shape of a human hand, the glove including a laminate preform attached by a lamination adhesive to a portion of an underlying glove shell, the method comprising:

providing a glove shell having a three-dimensional shape that approximates the shape of a human hand;

preparing a flat, solid laminate preform, the laminate preform including an exposed layer of lamination adhesive;

providing a three dimensional laminating form having a hand-shaped region, the hand-shaped region including a smooth laminating surface;

placing the glove shell on the laminating form so that the glove shell surrounds the hand-shaped region, and so that a portion of the glove shell conforms closely to the laminating surface without any seam or wrinkle;

placing the laminate preform on the glove shell above the laminating surface, the exposed layer of lamination adhesive being in direct contact with the glove shell;

applying a pressure above ambient pressure at a temperature above ambient temperature to the assembled laminate preform, glove shell, and laminating form, thereby causing the lamination adhesive to bond the laminate preform to the glove shell; and

removing the glove shell with the laminate preform bonded thereto from the laminating form.

18. The method of claim **17**, wherein the hand-shaped region of the laminating form includes a pair of opposing areas that are overlapping, substantially flat, and substantially parallel to each other, the laminating surface being included in one of the opposing areas.

19. The method of claim **17**, wherein applying pressure to the assembled lamination preform, glove shell, and laminating form includes applying pressure using at least one of a platen press, a roll press, a belt press, and a nip roll press.

20. The method of claim **17**, wherein the laminating surface is a non-flat, smooth surface.

21. The method of claim **20**, wherein applying pressure to the assembled lamination preform, glove shell, and laminating form includes applying pressure using at least one of a bladder press and a vacuum bag press.

22. The method of claim **17**, wherein

the glove shell is reversibly deformable;

placing the glove shell on the laminating form includes deforming the glove shell; and

removing the glove shell with the laminate preform bonded thereto from the laminating form includes allowing the glove shell with laminate preform bonded thereto to recover substantially to the pre-deformation shape of the glove shell.

23. The method of claim **22**, wherein the shape recovery of the glove shell is disproportionately located in regions of the glove shell to which the laminate preform is not bonded, thereby causing a warping deformation of the laminate preform.

24. The method of claim **22**, wherein placing the glove shell on the laminating form includes increasing the circumferences of the glove shell fingers by a factor of between 10% and 60%.

25. The method of claim **17**, further comprising, before placing the lamination preform on the glove shell, removing substantially all spin finish and lubricants from the portion of the glove shell that conforms closely to the laminating surface, such that a Soxhlet extraction with acetone yields less than 1.5% by weight of the textile.

26. The method of claim **17**, further comprising, before placing the lamination preform on the glove shell, removing substantially all spin finish and lubricants from the portion of the glove shell that conforms closely to the laminating surface, such that a Soxhlet extraction with acetone yields less than 0.5% by weight of the textile.

27. The method of claim **17**, wherein the laminate preform includes at least one of:

a textile layer;

an oriented film;

a layer of graphics;

a filler having a density that would cause the filler to settle if added to the liquid coating material; and

a filler having a density that, if added to the liquid coating material, would increase a viscosity of the liquid coating material, thereby rendering the liquid coating material unsuitable for dip-coating the glove shell.

28. The method of claim **17**, wherein preparing the flat, solid laminate preform includes at least one of printing, roll-to-roll coating, extrusion, stenting, blown extrusion, weaving, and knitting.

29. The method of claim **17**, wherein the pressure above ambient pressure is between 5 psi and 150 psi above ambient pressure.

30. The method of claim **17**, wherein the temperature above ambient temperature is between 200 degrees Fahrenheit and 375 degrees Fahrenheit.

31. The method of claim **17**, further comprising:

preparing a flat, solid inner laminate preform, the inner laminate preform including an exposed layer of inner lamination adhesive;

placing the inner laminate preform on the laminating form before placing the glove shell on the laminating form, so that the inner lamination adhesive is in direct contact with the inner surface of the glove shell; and wherein

applying pressure to the assembled laminate preform, glove shell, inner laminate preform, and laminating form causes the inner lamination adhesive to bond the inner laminate preform to the inner surface of the glove shell.

32. The method of claim **17**, further comprising attaching a cut-and-sew inner liner inside of the glove shell before placing the inner lining and glove shell on the laminating form.

* * * * *