A thin flexible glove that includes a fabric support liner, crush-resistant fingertips, and an elastomeric or polymeric shell disposed thereon and manufacturing methods for making the glove.
PLACE LINER ON FORMER 502

ATTACH FINGERTIPS TO LINER 504

DIP COAT LINER WITH FINGERTIPS INTO LATEX EMULSION 506

CURE COATING 508

FIG. 5
GLOVE HAVING CRUSH-RESISTANT FINGERTIPS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority under 35 U.S.C. 119(c) to U.S. Provision Application Ser. No. 61/539,251 filed Sep. 26, 2011, which is hereby incorporated by reference in its entirety.

BACKGROUND

[0002] 1. Field of the Invention
[0003] Embodiments of the present invention relate generally to protective articles such as gloves and other wearable items providing an inner fabric support and an outer polymeric coating and, particularly, to gloves having crush-resistant fingertips.

[0004] 2. Description of the Related Art
[0005] Gloves, and particularly gloves used in work settings, require properties providing safety while ensuring comfort during prolonged wear throughout the course of work activities. Fingers, and particularly fingertips, encounter the most danger and are often injured during work activities, such as from impact, crush, severance, and pinch hazards. However, workers often complain that gloves are too bulky and inflexible for the work that they perform. As a consequence, the gloves are often not worn, leading to even greater injuries. Accordingly, gloves must be flexible to be useful while performing work activities as well as inexpensive and easy to manufacture while protecting hands against additional concerns, such as protection from chemicals, oils, gases, and the like. Moreover, it is often desirable to protect workpieces (electronic equipment, touchscreens, and the like) from contact, natural skin oils, and perspiration by the wearer of the glove. Therefore, attempts have been made to create gloves addressing these needs.

[0006] One such glove discloses crush-resistant fingertips made of plastic or metal. Specifically, the glove comprises fingertips shaped as tubular members. The tubular members are inserted into or onto a liner. The liner may then be received within an outer glove. However, the glove requires many manufacturing steps, does not provide an integrally formed glove, and does not address many safety and other concerns.

[0007] Accordingly, there is a need for an improved glove and improved methods for manufacturing gloves that are comfortable and easy and inexpensive to manufacture while addressing the aforementioned concerns. It would therefore be a significant advance in the art to provide a comfortable, thin, flexible glove comprising a polymeric-coated knitted liner having crush-resistant fingertips.

SUMMARY

[0008] A thin flexible glove comprising a liner, crush-resistant fingertips, and a shell, and methods for manufacturing, substantially as shown in and/or described in connection with at least one of the figures, as set forth more completely in the claims, are disclosed. Various advantages and features of the present invention will be more fully understood from the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] So that the manner in which the above recited features of the present invention can be understood in detail, a more particular description of the invention, briefly summarized above, may be had by reference to embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only illustrative embodiments of this invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

[0010] FIG. 1 depicts a glove having rigid, crush-resistant fingertips inserted into the finger stalls of a liner, according to embodiments of the invention;

[0011] FIG. 2 depicts a glove having rigid, crush-resistant fingertips attached to the outside of the finger stalls of a liner, according to embodiments of the invention;

[0012] FIG. 3 depicts a glove having rigid, crush-resistant fingertips inserted into or attached onto a liner glove, and further including an outer coating over the liner, according to embodiments of the invention;

[0013] FIG. 4 depicts several rigid, crush-resistant fingertips, according to embodiments of the invention; and

[0014] FIG. 5 illustrates a typical manufacturing process, according to embodiments of the invention.

[0015] To facilitate understanding, identical reference numerals have been used, where possible, to designate comparable elements that are common to the figures. The figures are not drawn to scale and may be simplified for clarity. It is contemplated that elements and features of one embodiment may be beneficially incorporated in other embodiments without further recitation.

DETAILED DESCRIPTION

[0016] It has now been discovered that one can obtain thin, flexible gloves having protective properties, which include a liner and crush-resistant metal, composite, or plastic fingertips, and a foamed or unfoamed elastomeric or polymeric coating disposed thereon.

[0017] FIG. 1 depicts a glove having rigid, crush-resistant fingertips inserted into the finger stalls of a liner, according to embodiments of the invention. As seen in FIG. 1, the fabric support or liner 104 for the crush-resistant gloves 100 can be, for example, a knit material, a cut-and-sewn woven or non-woven fabric, cotton floss, fleece, or other suitable material. Crush-resistant fingertips 102 are disposed on the outside of the finger stalls of liner 104 of glove 100 and are delivered there through cuff 110 as shown by the directional arrow.

[0018] FIG. 2 depicts a glove having rigid, crush-resistant fingertips attached to the outside of the finger stalls of a liner, according to embodiments of the invention. The crush-resistant fingertips 102 are disposed on the outside of the finger stalls of liner 104 of glove 200. A shell comprising an elastomeric or polymeric coating can be applied by dip coating the support, as is discussed below. Alternatively, the shell may be sprayed onto the liner and fingertips, as is known in the art. FIG. 3 depicts a glove having rigid, crush-resistant fingertips inserted into or attached onto a liner glove, and further including an outer coating over the liner, according to embodiments of the invention. The liner 104 of glove 300 is coated with an elastomeric or polymeric layer 106. In some embodiments, the crush-resistant fingertips 102 may be adhered to the inside of the finger stalls of liner 104 or, alternatively, the fingertips 102 may be adhered to the outside of liner 104, and the resulting intermediate glove coated with an elastomeric or polymeric coating 106. A glove with an elastomeric or polymeric coating may comprise a palm dip that covers at least the fingertips, a three-quarters dip as shown in FIG. 3, or a full
dip, which result in different level of protection. When applying the coating substantially to all of a glove, all or part of cuff area 108 may nonetheless be uncoated. In another embodiment, the finger and palm areas may be coated, while the back of the hand (exclusive of the fingertips) may be uncoated.

[0019] FIG. 4 depicts several rigid, crush-resistant fingertips, according to embodiments of the invention. The crush-resistant fingertips may be of many different sizes and shapes. In some embodiments, the fingertip may comprise an open-end for enhanced tactile sensation. Open-ended fingertips, which allow the palm-side of the fingers to extend through the crush resistant fingertips, also allow the gloves, knitted from conductive yarns, to be used with capacitive touchscreen technologies, such as those disclosed in commonly assigned U.S. Pat. No. 7,434,422, which is incorporated herein by reference in its entirety. FIG. 4 shows crush-resistant fingertip 402 having an embodiment of an open-ended fingertip, with the finger of a user entering fingertip 402 from direction A. Fingertips may alternately be cylindrical or conical in shape, as in fingertip 404 with the finger of a user entering fingertip 402 from direction A. Alternately, the fingertips may comprise a slightly-bent orientation, as shown in fingertip 406, such as an index finger might be when engaging the thumb, which can alleviate stresses and fatigue during use for some activities. Fingertip 408 comprises a series of rings 410 having varying diameters, the smallest diameters closest to the end of the fingertip and gradually increasing in size, like the finger itself, and joined together at one or a plurality of points 412 to stabilize the structure.

[0020] In yet other embodiments of the invention, the inside and outside surfaces of the crush-resistant fingertips can comprise surface treatments, surface finishes, roughened surfaces, and the like to promote adhesion of the fingertips to the liner and shell. For example, where the fingertips are injection molded components and are to be, for example, glued on a liner for attachment, the inside surface may be formed having one of several different electric discharge machine (EDM) finishes known to those of ordinary skill in the art. Alternatively, if the fingertip is to be placed within a liner for attachment by gluing, the outside surface of the fingertip may have one of several different EDM finishes. Furthermore, the material the crush-resistant fingertips components are made of can be selected to balance service properties with manufacturability concerns, such as choosing a plastic that easily bonds with both a specific adhesive and the adhesive to a specific liner yarn. In some embodiments, the crush-resistant fingertips may comprise metals, plastics, and/or reinforced composite materials such as carbon-reinforced fiber composites and the like. In some embodiments of the invention, the plastics and/or composite materials may be doped with metallic materials to add conductivity properties. Carbon-reinforced materials are also used where conductive applications are contemplated. In addition, any of the crush-resistant fingertips may comprise embodiments addressing other service concerns, such as puncture and chemical resistance.

[0021] The support/liner 104 can be made from a yarn having one of various deniers and using 7, 10, 13, 15, or 18 knit gauges, and can be comprised of such materials as Kevlar®, p-aramids, Nomex®, m-aramids, Spectra®, Dynema®, Tsunooga® SPANDEX®, polyesters, rayon, cotton, metal wires, fiberglass, and the like, and blends of the foregoing. Various yarns may be specified for flame- and/or heat-resistance as well as for cut-resistance. In some embodiments, the yarns may be treated with chemicals to impart properties known to those having ordinary skill in the art. In some embodiments of the invention, knitted liners may have various yarns plaited into the knit to impart a balance of properties, for instance, comfort, moisture control and absorbance, scratch resistance, cushioning, strength, and the like. Also, if the support is a knitted liner, the knitted liners may comprise separately knitted sections, and knitted variable stitch dimensions, such as those disclosed in commonly assigned U.S. Pat. No. 6,962,064 and U.S. Patent Appl. Publ. 2009/0211305, which are incorporated herein by reference in their entirety.

[0022] FIG. 5 illustrates a typical manufacturing process, according to embodiments of the invention. Method 500 for manufacturing gloves is disclosed. The liner 104 is placed on a former at step 502. At step 504, the inside surface of crush-resistant fingertips may be attached to the outside surface of the liner, either before or after the liner is placed on the former. The liner having the crush-resistant fingertips may then be optionally coated with an elastomeric coating at step 506 and the elastomeric coating cured at step 508. Techniques for fabricating such a dipped glove are well known and disclosed, for example, in commonly assigned U.S. Pat. No. 7,803,438, incorporated herein by reference in its entirety.

[0023] The fingertips may be attached to the liner using adhesives, hot melts, or sprayed adhesives, or other suitable attachment means. In other embodiments, the fingertips are held in place on the inside or outside surface of the liner with friction. For example, as discussed above, a series of rings having varying diameters may impart friction on the liner and/or on the fingers of the wearer to hold the fingertips in place. This alternative has the added feature of allowing greater circulation of air around the fingers, which can promote comfort and breathability. Other embodiments contemplate wherein the rings are oval-shaped and/or sized so that the crux of a wearer's finger at the knuckle receives a ring 410. In yet other embodiments, the fingertips may be held in place by forcing oversized fingertips into the finger stalls of the liner and stretching the yarn of the liner, creating an interference fit.

[0024] In other embodiments, the coating may be disposed on the liner via a molding process, such as an injection-molding process, and may coat the palm area or be extended to a ¼ coating (palm, fingers, knuckles) or full coat to the wrist.

[0025] Alternately, any of the foregoing embodiments of the crush-resistant fingertips may be molded directly onto the former-supported liner using a molding process, such as transfer, compression, or injection molding. The injection-molded components may have engineered profiles, textures, finishes, or contours to impart properties promoting ease of use during service, gripability, and the like. Such embodiments are included in commonly assigned provisional application 61/464,956, filed on Mar. 11, 2011, which is incorporated herein by reference in its entirety. Furthermore, the crush-resistant fingertips may be injection-molded directly onto a glove already comprising an elastomeric-coated liner. This glove may also then be coated with an additional elastomeric coating. It is further to be noted that any of the various fingertip designs can be incorporated into any embodiment of any glove liner and shell/coating disclosed herein.

[0026] In some embodiments of the invention, the support/liner can be mounted onto a former and optionally dipped into a coagulant composition; and dipped into an elastomeric or polymeric emulsion; forming the coating from the emulsion,
such as a coating that penetrates less than the entire thickness of the support; and curing the coating. The coating can be applied to all or most of the support, or a portion thereof. After dipping, the former can be turned over to distribute the elastomeric or polymeric material evenly. The dipping depth into the emulsion composition can be chosen to ensure that the resulting coating penetrates the glove body for good adhesion but with minimal to no strikethrough to the hand-contacting side. The process variables, which control the penetration of the polymeric or elastomeric emulsion can include: control of viscosity of the emulsion and control of dip depth in the elastomeric or polymeric emulsion tank. Without intending to be bound by theory, hydraulic pressure in the tank of aqueous polymeric emulsion can contribute to the depth of penetration. Typical elastomeric or polymeric materials that may be used include natural rubbers, synthetic rubbers, guayule, natural and synthetic polyisoprene, butadiene, styrene-butadiene, nitriles, poly (vinyl chloride), polyurethanes, polychloroprene, blends, mixtures thereof, and the like. The coating may optionally be foamed, produced using a suitable combination of a surfactant, control of air content in the foamed coating, control of the viscosity of the elastomeric layers and suitable former temperatures for liner supported dipping processes.

The concentration of the coagulant can be varied to regulate the amount the polymer penetrates the support. Similarly, the amount and orientation of pre-cure drying can be adjusted to limit excessive penetration. The support/liner can be partially dried after dipping into a coagulant solution. Coagulant solutions that can be used with the invention include calcium nitrate, calcium citrate, acetic acid, tricarbonyl iron, aluminum sulfate, zinc acetate, sodium chloride, alcohol, dilute HCl, formic acid, other divalent and trivalent metal ion salts, mixtures thereof, and the like.

Although some embodiments have been discussed above, other implementations and applications are also within the scope of the following claims. Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the following claims.

Publications and references, including but not limited to patents and patent applications, cited in this specification are herein incorporated by reference in their entirety as if each individual publication or reference were specifically and individually fully set forth herein. Any patent application to which this application claims priority is also incorporated by reference herein in the manner described above for publications and references.

What is claimed is:

1. A thin flexible glove, comprising: a fabric support liner; crush-resistant fingertips; and an elastomeric or polymeric shell disposed over the liner and crush-resistant fingertips, wherein the crush-resistant fingertips may be on the inside of the liner or the outside of the liner.

2. The glove of claim 1 wherein the elastomeric or polymeric shell comprises a material chosen from one of natural rubbers, guayule, synthetic rubbers, natural or synthetic polyisoprene, butadienes, styrene-butadienes, nitriles, poly (vinyl chloride), polyurethanes, polychloroprene, or blends or mixtures thereof.

3. The glove of claim 1 wherein the fabric support liner comprises a knitted liner.

4. The glove of claim 3 wherein the knit liner has a gauge of 7 to 18.

5. The glove of claim 1 wherein the elastomeric or polymeric shell is foamed.

6. The glove of claim 5 wherein the elastomeric or polymeric foamed shell comprises about 70% open cell air content upon collapse of the foamed shell after curing.

7. The glove of claim 1 wherein the crush-resistant fingertips are made of metal, plastic, or reinforced composite materials such as carbon-reinforced fiber composites.

8. The glove of claim 7 wherein the crush-resistant fingertips are open-ended.

9. A method of making a glove, comprising: providing a fabric support liner; placing the liner onto a former, and attaching crush-resistant fingertips onto or within the finger stalls of the liner.

10. The method of claim 9, further comprising the step of dipping the fabric support liner on the former into an elastomeric or polymeric emulsion, to form a coating on the fabric support liner; and curing the coating.

11. The method of claim 10, further comprising the step of disposing a coagulant on the liner before the dipping step.

12. The method of claim 10, wherein the elastomeric or polymeric mixture is foamed to about 150-200% air content by volume.

13. The method of claim 9, wherein the attaching step is chosen from gluing, using adhesives, using frictional forces, or molding.

14. The method of claim 9, wherein the crush-resistant fingertips are made of metal, plastic, or composite materials.

15. The method of claim 9, wherein the crush-resistant fingertips are closed- or open-ended.

16. The method of claim 13, wherein an elastomeric coating is molded over the liner.

17. The method of claim 13, wherein the crush-resistant fingertips comprise a plurality of rings having varying diameters and joined at one or more points.

18. A method of making a glove, comprising: providing a fabric support liner; placing the liner onto a former, and molding crush-resistant fingertips onto or within the finger stalls of the liner.

19. The method of claim 18, wherein the fabric support liner further comprises dipping the glove into a latex composition to form an outer polymeric coating.
20. The method of claim 19, wherein the glove having molded, crush-resistant fingertips and an outer polymeric coating further comprises the step of dipping the glove into a latex composition to form a second polymeric coating.