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(54) **ARTICLE OF FOOTWEAR CONTAINING A PHOTOREACTIVE COMPOSITION**

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(75) Inventors: **John T. Weaver**, Saint Charles, MO (US); **Tom Ledwon**, Maryland Heights, MO (US); **Hanson Wu**, Paichung (TW)

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Correspondence Address:
DORITY & MANNING, P.A.
POST OFFICE BOX 1449
GREENVILLE, SC 29602-1449 (US)

(57) **ABSTRACT**

An article of footwear that includes a photoreactive composition capable of reversibly changing color when contacted with ultraviolet light is provided. The photoreactive composition is incorporated into a panel member that is secured to the article of footwear. For example, in one embodiment, a photoreactive composition, which is initially optically transparent, is contacted with ultraviolet light so that it changes to one or more visible colors (e.g., violet, blue, red, orange, yellow, etc.) during exposure, and then returns substantially to its original color in the absence of ultraviolet light. Likewise, in another embodiment, a photoreactive composition, which initially has one or more visible colors, is contacted with ultraviolet light so that it changes to one or more different visible colors.

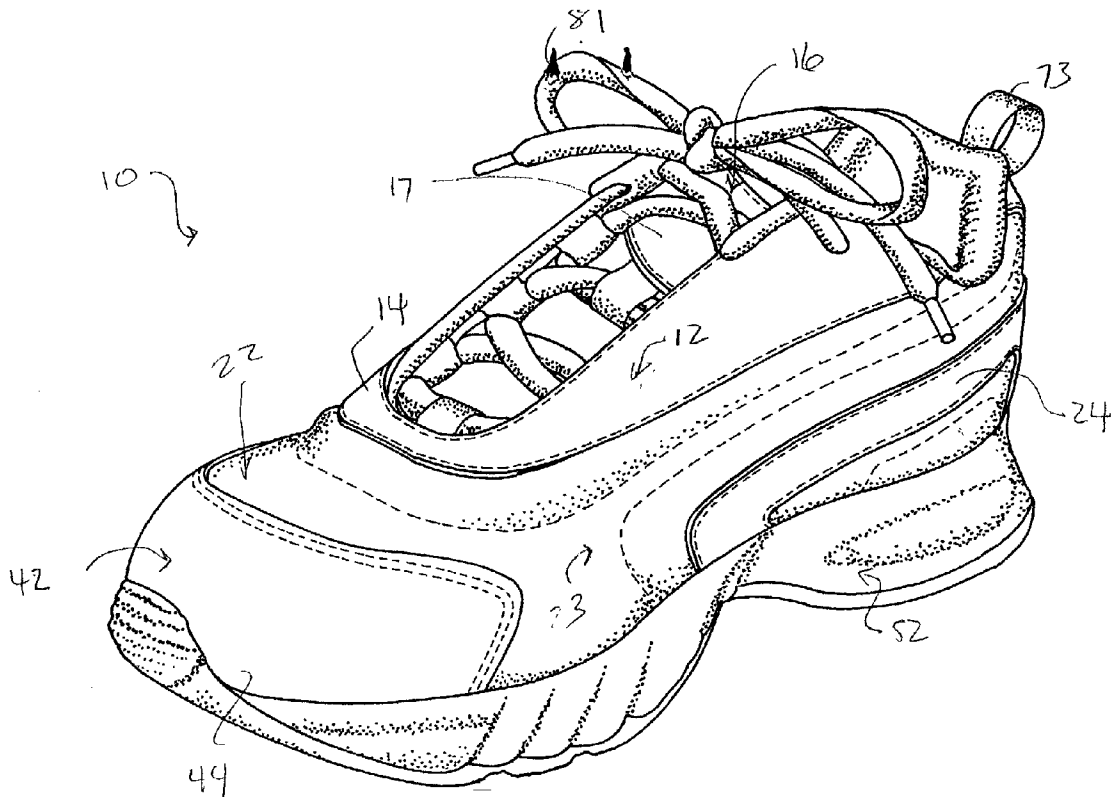
(73) Assignee: **Elan-Polo, Inc.**

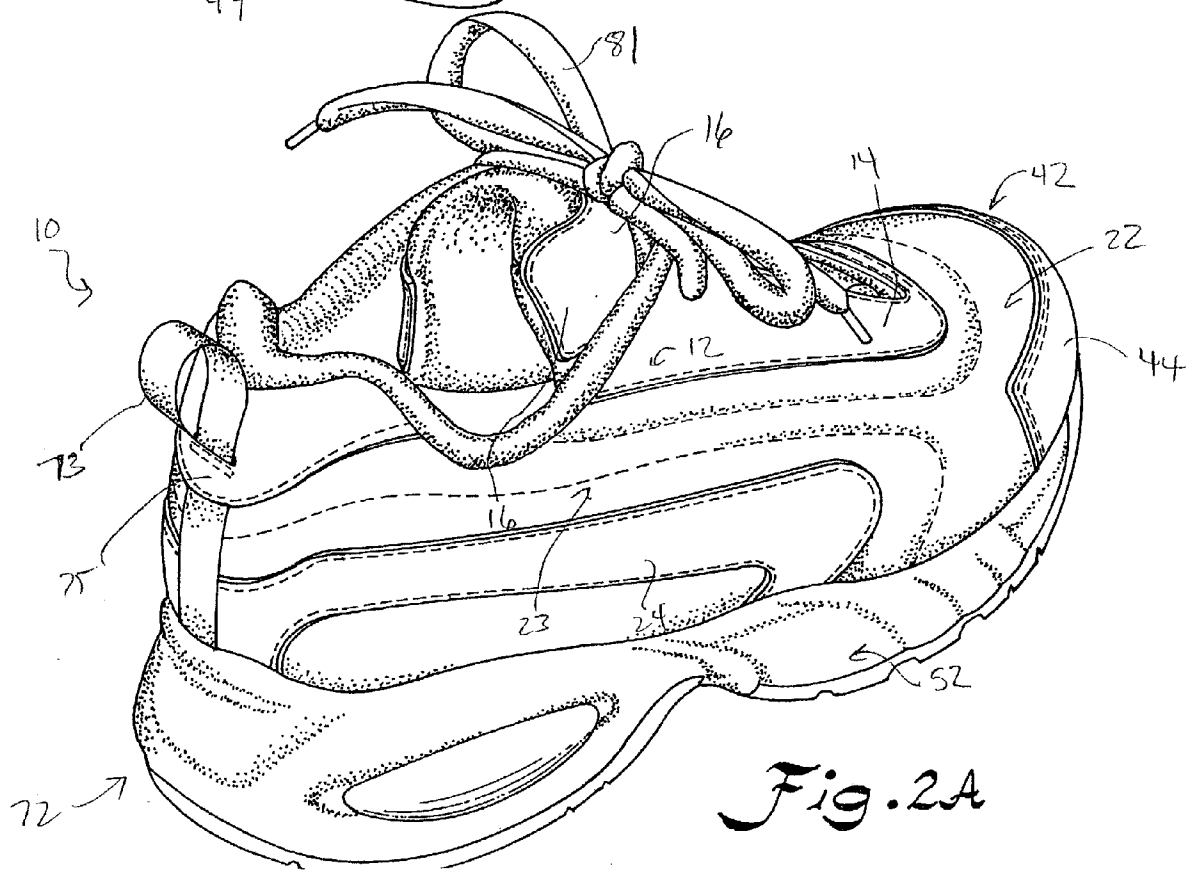
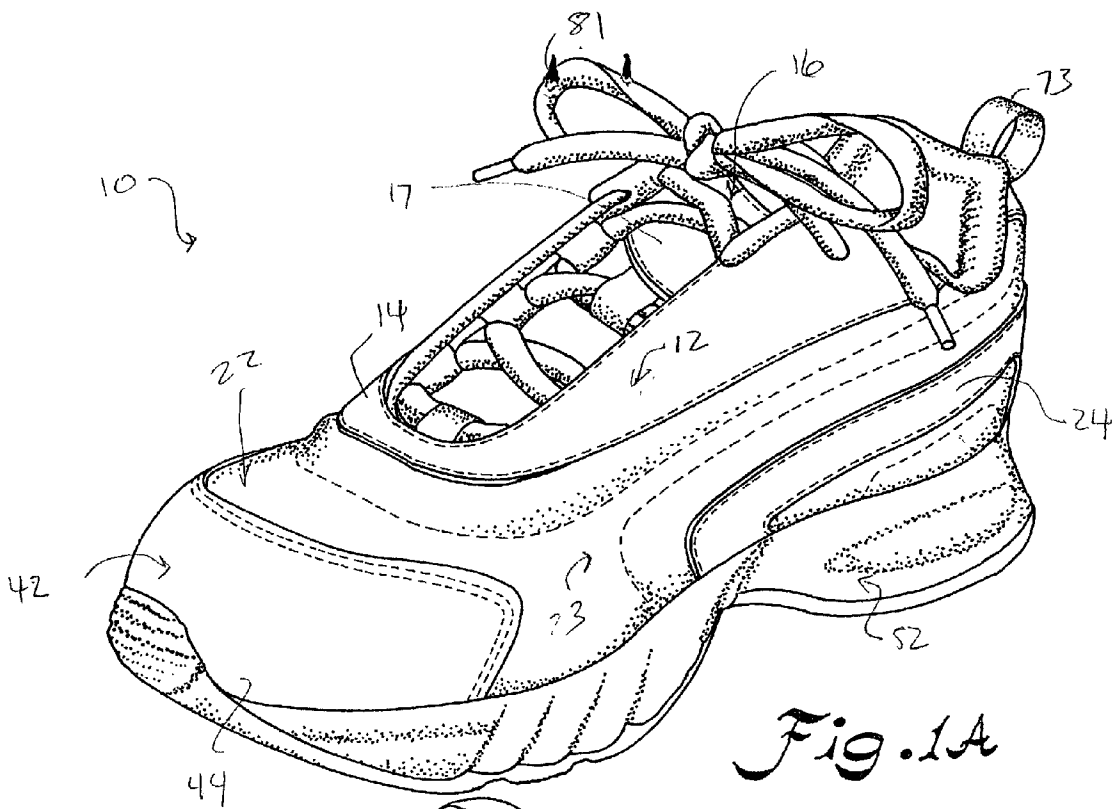
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Brief Introduction to Photochromic Dyes

Principles and Chemical Structures:

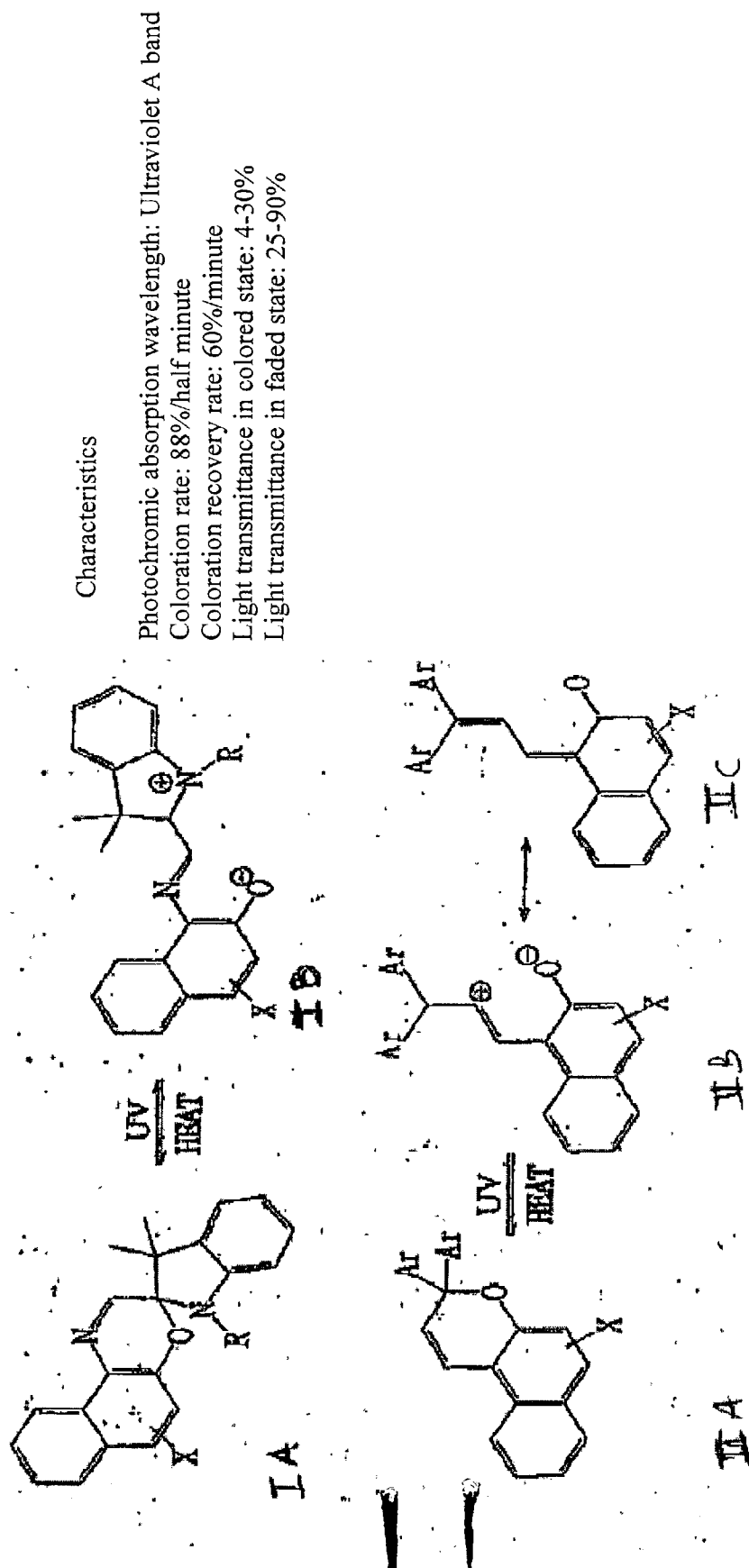


FIG. 3

ARTICLE OF FOOTWEAR CONTAINING A PHOTOREACTIVE COMPOSITION

RELATED APPLICATIONS

[0001] The present application claims priority to U.S. Provisional Application Serial No. 60/309,338, filed on Aug. 1, 2001.

BACKGROUND OF THE INVENTION

[0002] In the past, many attempts have been made to decorate shoes to form creative designs that may interest consumers. For instance, shoes have been developed that contain a material that changes from no color to a color or from one color to another color when exposed to ultraviolet rays via sunlight. One such conventional shoe is a "canvas shoe" screen-printed with a UV-reactive material and marketed by SunWorks. However, one problem often experienced with these screen-printed, UV-reactive shoes was that the UV-reactive material was easily removed from the shoe after only a short period of exposure to sunlight. Furthermore, the printed shoes were also aesthetically unappealing and relatively costly.

[0003] As such, a need currently exists for an improved article of footwear that can change color when exposed to ultraviolet light.

SUMMARY OF THE INVENTION

[0004] In accordance with one embodiment of the present invention, an article of footwear (e.g., shoes, boots, sandals, etc.) is disclosed that includes at least one panel member. The panel member contains an optically transparent polymeric material and a photoreactive composition that is capable of undergoing a reversible color change upon exposure to ultraviolet light. For instance, in one embodiment, the photoreactive composition changes from being optically transparent to having one or more visible colors upon exposure to ultraviolet light. In another embodiment, the photoreactive composition changes from having a first visible color to having a second visible color upon exposure to ultraviolet light.

[0005] Any of a variety of different materials may be used for the photoreactive composition and polymeric material of the panel member. For instance, in some embodiments, the photoreactive composition is selected from the group consisting of spiropyrans, spirooxazines, and combinations thereof. If desired, the photoreactive composition may also contain additional components, such as an ultraviolet stabilizer, an antioxidant, or combinations thereof. Further, in some embodiments, the polymeric material of the panel member may be selected from the group consisting of polyol(allyl carbonate)-polymers, polyacrylates, polyethylene, polypropylene, polyvinyl chloride, polymethyl methacrylates, cellulose acetate, cellulose triacetate, cellulose acetate propionate, cellulose acetate butyrate, polyacetal resin, acetyl cellulose, poly(vinyl acetate), poly(vinyl alcohol), polyurethanes, polycarbonates, polystyrene, poly(styrene methylmethacrylate) copolymers, poly(styrene acrylonitrile) copolymers, polyvinylbutyral, and combinations thereof.

[0006] The panel member may be attached to the article of footwear using any technique known in the art. For example,

the panel member may be stitched to the article of footwear or secured thereto with an adhesive.

[0007] In accordance with another embodiment of the present invention, an article of footwear (e.g., shoes, boots, sandals, etc.) is disclosed that comprises:

[0008] a) an outsole;

[0009] b) an upper attached to the sole, the upper being adapted to reside at least partially about the foot of a wearer; and

[0010] c) at least one panel member secured to the upper, the panel member containing an optically transparent polymeric material and a photoreactive composition that is capable of undergoing a reversible color change upon exposure to ultraviolet light.

[0011] In still another embodiment of the present invention, a shoe is disclosed that comprises:

[0012] a) an outsole;

[0013] b) an upper attached to the sole, the upper including a vamp, a toe portion, quarters, and a heel portion; and

[0014] c) at least one panel member secured to the upper, the panel member containing an optically transparent polymeric material and a photoreactive composition that is capable of undergoing a reversible color change upon exposure to ultraviolet light.

[0015] In one embodiment, the panel member can be secured to the vamp, quarters, toe portion, heel portion, or combinations thereof. Further, the shoe may also comprise a tongue. In one embodiment, the panel member may be attached to the tongue.

[0016] Other features and aspects of the present invention are discussed in greater detail below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] A full and enabling disclosure of the present invention, including the best mode thereof, directed to one of ordinary skill in the art, is set forth more particularly in the remainder of the specification, which makes reference to the appended figures in which:

[0018] **FIG. 1** is a perspective view of one side of an article of footwear formed according to one embodiment of the present invention, in which **FIG. 1A** illustrates the article of footwear in an inactivated state and **FIG. 1B** illustrates the article of footwear after it has been contacted with ultraviolet light;

[0019] **FIG. 2** is a perspective view of another side of the article of footwear shown in **FIG. 1**, in which **FIG. 2A** illustrates the article of footwear in an inactivated state and **FIG. 2B** illustrates the article of footwear after it has been contacted with ultraviolet light; and

[0020] **FIG. 3** is an illustration of various chemical compounds that can be used as the photoreactive composition in accordance with some embodiments of the present invention.

[0021] Repeat use of reference characters in the present specification and drawings is intended to represent same or analogous features.

DETAILED DESCRIPTION OF REPRESENTATIVE EMBODIMENTS

[0022] It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not intended as limiting the broader aspects of the present invention, which broader aspects are embodied in the exemplary construction.

[0023] The present invention is generally directed to a unique article of footwear that includes a photoreactive composition capable of reversibly changing color when contacted with ultraviolet light (e.g., light having a wavelength of from about 180 to about 400 nanometers (nm)). The photoreactive composition is incorporated into a panel member that is secured to the article of footwear. For example, in one embodiment, a photoreactive composition, which is initially optically transparent, is contacted with ultraviolet light so that it changes to one or more visible colors (e.g., violet, blue, red, orange, yellow, etc.) during exposure, and then returns substantially to its original color in the absence of ultraviolet light. Likewise, in another embodiment, a photoreactive composition, which initially has one or more visible colors, is contacted with ultraviolet light so that it changes to one or more different visible colors. It has been discovered that the present invention can provide a relatively permanent, aesthetic, and inexpensive technique for imparting a UV-reactive decorative feature to an article of footwear.

[0024] Any of a variety of reversibly photoreactive compositions may be utilized in the present invention to provide the desired color change upon exposure to ultraviolet light. For example, some suitable photoreactive compositions that may be used in the present invention are described in U.S. Pat. Nos. 4,980,089 to Heller; 5,581,090 to Goudjil; and 5,914,917 to Goudjil, which are incorporated herein in their entirety by reference thereto for all purposes. These patents describe the use of various photochromic compounds. Among the large family of photochromic compounds include a family of molecules called spiropyrans (i.e., trimethylindolinospirobenzopyran). For instance, one example of a spiropyran is 1',3',3'-trimethylspiro[2H-1-benzopyran-2,2'-indoline]. In addition, spirooxazines are also included within the family of photochromic compounds. Generally, the chemical structure of spirooxazine is almost identical to the spiropyran group, except that the double carbon bond in the spiropyran in the pyran ring is replaced by a C=N bond in the case of spirooxazine. For instance, some examples of spirooxazines include 1',3',3'-trimethylspiro[2H-1,4-benzoxazine-2,2'-indoline] (also called "BISO"); 1',3',3'-trimethylspiro[indoline-2',3'-[3 H]naphth[2,1-b][1,4]oxazine]; 3-ethyl-9'-methoxy-1,3-dimethylspiro[indoline-2,3'-[3 H]naphth-[2,1-b][1,4]oxazine] (also called "NISO"); 1,3,3-trimethylspiro[indoline-2,3'-[3H]pyrido[3,2-f]-[1,4]benzoxazine] (also called "QISO"); and oxazolidinospirooxazine. These photochromic molecules are well known for photoreacting to ultraviolet light by changing from clear to a variety of colors and shades. For example, a spiropyran appears as a colorless compound that undergoes a photochemical transformation under UV radiation to an intensely colored open chain merocyanine.

[0025] Referring to FIG. 3, specific examples of chemical structures that reversibly change color upon exposure to ultraviolet light are illustrated. As shown, when exposed to

ultraviolet light, the structure of Formula IA, which is a spirooxazine, is altered to form the structure of Formula IB. Similarly, upon exposure to ultraviolet light, the structure of Formula IIA, which is a spiropyran, is altered to form Formulae IIB and IIC. After these altered structures are returned to ambient temperatures and the ultraviolet light source is removed, the structures transform back to their initial states, i.e., Formulae IA and IIA. In this particular embodiment, the photoreactive composition undergoes an 88% color change in 30 seconds and recovers 60% of its original color in 1 minute. Further, the light transmittance in the colored (i.e., UV-reacted) state is from 4 to 30%, while the light transmittance in the faded (i.e., original) state is 25-90%.

[0026] Further, other materials may also be utilized in conjunction with the photoreactive composition. For example, in some embodiments, various well-known ultraviolet stabilizers and/or antioxidants may be used to enhance the life of the photoreactive composition. Although not required, the stabilizers and antioxidant may each be utilized in an amount less than about 10% by weight. For instance, in some embodiments, the stabilizers and antioxidants may each be present in an amount of from about 0.10 wt. % to 1.0 wt. %.

[0027] Some examples of suitable ultraviolet stabilizers may include, but are not limited to, benzophenones, salicylic acids, cyanoacrylates, benzotriazoles, oxanilides, and the like. Some examples of suitable antioxidants may include, but are not limited to, Irganox 1010 [tetrakis (methylene(3,5-di-tert-butyl-4-hydroxycinnamate))] methane (Ciba-Geigy); Irganox 1076 [octadecyl 3,5 di-tert-butyl-4-hydroxyhydrocinnamate] (Ciba-Geigy); Irganox 245 [ethylenebis (oxyethylene) bis-(3-tert-butyl-4-hydroxy-5-methylhydrocinnamate)] (Ciba-Geigy); and Vanox 830 (a blend of a phenolic compound, alkylated diphenylamines and trialkyl phosphite from R. T. Vanderbilt). Still other examples of suitable ultraviolet stabilizers (or absorbers) and antioxidants are described in U.S. Pat. No. 5,688,592 to Shibahashi, et al., which is incorporated herein in its entirety by reference thereto for all purposes.

[0028] Once a particular photoreactive composition (including other optional ingredients) is selected, it is then incorporated into a panel member for application to an article of footwear. For example, in some embodiments, the photoreactive composition is a "powderlike" substance that is dispersed within an optically transparent polymeric material. Examples of some suitable optically transparent polymers may include, but are not limited to, polyol(allyl carbonate)-polymers, polyacrylates, polyethylene, polypropylene, polyvinyl chloride, polymethyl methacrylates, cellulose acetate, cellulose triacetate, cellulose acetate propionate, cellulose acetate butyrate, polyacetal resin, acetyl cellulose, poly(vinyl acetate), poly(vinyl alcohol), polyurethanes, polycarbonates, polystyrene, poly(styrene methylmethacrylate) copolymers, poly(styrene acrylonitrile) copolymers, polyvinylbutyral, and the like. Various techniques may be utilized to disperse the photoreactive composition within the polymeric material. For example, in one embodiment, the photoreactive composition is first mixed with pellets of the polymeric material and then introduced into an injection-molder or extruder. As is well known in the art, the injection-molder or extruder can then

form the materials into a hardened plastic that is optionally molded and/or cut into a desired panel member shape.

[0029] Once formed, the panel members may generally be applied to the article of footwear in any manner desired. For example, in some embodiments, the panel members can be stitched onto the footwear. In other embodiments, the panel members can be glued to the footwear using well-known adhesives. Any number of panel members may be applied to the article of footwear, and each panel member may have any desired shape or size and may be secured to at location on the article of footwear. In addition, more than one photoreactive composition may also be incorporated into a single panel member. For example, in one embodiment, multiple photoreactive compositions can be incorporated into a panel member so that, when exposed to an ultraviolet source, multiple colors are produced.

[0030] In accordance with the present invention, the panel member containing the photoreactive composition may then be disposed on a surface of the article of footwear. Some examples of articles of footwear that can be formed according to the present invention include, but are not limited to, shoes (e.g., athletic, walking, etc.), boots, sandals, and the like. For example, referring to FIGS. 1-2, one embodiment of an athletic shoe 10 formed according to the present invention will now be described in more detail. It should be understood, however, that the embodiment discussed below is merely exemplary, and that other article of footwear configurations are contemplated in the present invention.

[0031] In this regard, the shoe 10 includes an outsole 52 that is typically molded from an elastomer, which gives it a good measure of flexibility and some resilience, yet enough stiffness to support the user without significant deformation. A shoe upper 22 or outer covering is secured to the outsole 54. The upper 22 contains a vamp 12, a toe portion 42 and quarters 23 that extend along a heel portion 72 and forwardly to merge with the vamp 12. The quarters 23 create an opening that receives the user's foot, and that opening extends forwardly into the vamp 24 where it is occupied by a tongue 16. Furthermore, the shoe 10 also includes laces 81 for securing the shoe to a foot. If desired, the shoe 10 may further include a strap 73 to aid in positioning the foot within the shoe 10.

[0032] Various panel members 14, 17, 24, 44, and 75 that may contain one or more photoreactive compositions are also shown secured to the shoe 10. In this embodiment, the first panel member 14 is secured to the vamp 12, the second panel member 17 is secured to the tongue 16, the third panel member 24 is secured to the quarters 23, the fourth panel member 44 is secured to the toe portion 42, and the fifth panel member 75 is secured to the heel portion 72. Although not required, each panel member in the illustrated embodiment is generally shaped and molded to approximate the shape and contours of the shoe portion to which the particular panel member is attached. Such a seamless securement of the panel members can sometimes provide a more appealing appearance to consumers.

[0033] Once the shoe 10 is secured with the panel member(s), such as described above, it is then ready for use. Specifically, when the shoe 10 is exposed to ultraviolet light, the photoreactive composition(s) contained within the panel member(s) changes color. Because the polymeric material of the panel member(s) is optically transparent, this color

change will be readily apparent when viewing the shoe 10. For example, referring to FIGS. 1B and 2B, one embodiment of a UV-reacted shoe is shown. In particular, each of the panel members 4, 17, 24, 44, and 75 are shaded to reflect the resulting color change. Once the ultraviolet light source is removed, the panel members 4, 17, 24, 44, and 75 will return to their initial inactivated and colorless state, as reflected in FIGS. 1A and 2A.

[0034] As a result of the present invention, it has been discovered that an article of footwear can be formed with a material that reversibly changes color when exposed to ultraviolet light, such as provided by sunlight. Moreover, because such a material is contained within a panel member, the "ultraviolet-reactive effect" can be achieved for a longer period of time. Further, due to its transparent and glossy nature, the panel member can also accentuate the color change of the photoreactive composition.

[0035] These and other modifications and variations to the present invention may be practiced by those of ordinary skill in the art, without departing from the spirit and scope of the present invention, which is more particularly set forth in the appended claims. In addition, it should be understood that aspects of the various embodiments may be interchanged both in whole or in part. Furthermore, those of ordinary skill in the art will appreciate that the foregoing description is by way of example only, and is not intended to limit the invention so further described in such appended claims.

What is claimed is:

1. An article of footwear, wherein at least one panel member is secured to said article of footwear, said panel member containing an optically transparent polymeric material and a photoreactive composition that is capable of undergoing a reversible color change upon exposure to ultraviolet light.
2. An article of footwear as defined in claim 1, wherein said photoreactive composition changes from being optically transparent to having one or more visible colors upon exposure to ultraviolet light.
3. An article of footwear as defined in claim 1, wherein said photoreactive composition changes from having a first visible color to having a second visible color upon exposure to ultraviolet light.
4. An article of footwear as defined in claim 1, wherein said photoreactive composition is selected from the group consisting of spiropyrans, spirooxazines, and combinations thereof.
5. An article of footwear as defined in claim 1, wherein said photoreactive composition further comprises an ultraviolet stabilizer, an antioxidant, or combinations thereof.
6. An article of footwear as defined in claim 1, wherein said polymeric material is selected from the group consisting of polyol(allyl carbonate)-polymers, polyacrylates, polyethylene, polypropylene, polyvinyl chloride, polymethyl methacrylates, cellulose acetate, cellulose triacetate, cellulose acetate propionate, cellulose acetate butyrate, polyacetal resin, acetyl cellulose, poly(vinyl acetate), poly(vinyl alcohol), polyurethanes, polycarbonates, polystyrene, poly(styrene methylmethacrylate) copolymers, poly(styrene acrylonitrile) copolymers, polyvinylbutyral, and combinations thereof.
7. An article of footwear as defined in claim 1, wherein said panel member is formed by injection molding.

8. An article of footwear as defined in claim 1, further comprising a sole and an upper attached to said sole, said upper including portions adapted to reside at least partially about the foot of a wearer.

9. An article of footwear as defined in claim 8, wherein said panel member is secured to said upper.

10. An article of footwear as defined in claim 1, wherein said panel member is stitched to said article of footwear.

11. An article of footwear as defined in claim 1, wherein said panel member is secured to said article of footwear with an adhesive.

12. An article of footwear as defined in claim 1, wherein the article of footwear is a shoe.

13. An article of footwear as defined in claim 1, wherein the article of footwear is a boot.

14. An article of footwear as defined in claim 1, wherein the article of footwear is a sandal.

15. An article of footwear comprising:

a) an outsole;

b) an upper attached to said sole, said upper being adapted to reside at least partially about the foot of a wearer; and

c) at least one panel member secured to said upper, said panel member containing an optically transparent polymeric material and a photoreactive composition that is capable of undergoing a reversible color change upon exposure to ultraviolet light.

16. An article of footwear as defined in claim 15, wherein said photoreactive composition changes from being optically transparent to having one or more visible colors upon exposure to ultraviolet light.

17. An article of footwear as defined in claim 15, wherein said photoreactive composition changes from having a first visible color to having a second visible color upon exposure to ultraviolet light.

18. An article of footwear as defined in claim 15, wherein the article of footwear is a shoe.

19. An article of footwear as defined in claim 15, wherein the article of footwear is a boot.

20. An article of footwear as defined in claim 15, wherein the article of footwear is a sandal.

21. A shoe comprising:

a) an outsole;

b) an upper attached to said sole, said upper including a vamp, a toe portion, quarters, and a heel portion; and

c) at least one panel member secured to said upper, said panel member containing an optically transparent polymeric material and a photoreactive composition that is capable of undergoing a reversible color change upon exposure to ultraviolet light.

22. A shoe as defined in claim 21, wherein said photoreactive composition changes from being optically transparent to having one or more visible colors upon exposure to ultraviolet light.

23. A shoe as defined in claim 21, wherein said photoreactive composition changes from having a first visible color to having a second visible color upon exposure to ultraviolet light.

24. A shoe as defined in claim 21, wherein said panel member is secured to said vamp, said quarters, said toe portion, said heel portion, or combinations thereof.

25. A shoe as defined in claim 21, further comprising a tongue.

26. A shoe as defined in claim 25, wherein said panel member is secured to said tongue.

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