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(54) **LAYERED ENVIROCHROMIC MATERIALS, APPLICATIONS AND METHODS OF PREPARATION THEREOF**

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(57) **ABSTRACT**

A layered envirochromic material is described herein that contains at least one substrate or surface material; at least one base layer coupled to the at least one substrate or surface material; and at least one envirochromic layer coupled to the at least one base layer. Methods of producing the layered envirochromic materials include providing a surface or substrate; applying at least one base layer component on to the surface; curing the at least one base layer component to form a base layer; applying at least one envirochromic layer component on to the surface; and curing the at least one envirochromic layer component to form the envirochromic layer. Additional methods include providing a surface or substrate; applying at least one base layer component on to the surface; applying at least one envirochromic layer component on to the at least one base layer component; and curing the at least one base layer component and at least one envirochromic layer component to form the layered material.

LAYERED ENVIROCHROMIC MATERIALS, APPLICATIONS AND METHODS OF PREPARATION THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Patent Application Ser. No. 60/637,535, filed Dec. 20, 2004 (Attorney Docket No. 7044531001), titled, "Layered Envirochromic Materials, Applications and Methods of Preparation Thereof," which is incorporated by reference herein for all purposes.

FIELD OF THE SUBJECT MATTER

[0002] The field of the subject matter disclosed herein is envirochromic materials, specifically layered envirochromic materials, applications of those materials and methods of preparation thereof.

BACKGROUND

[0003] In the 21st century, consumers are looking for more information about the products that they buy, and they are also looking for more from those products. Desirable products are those that meet specific needs and in some cases, provide added benefits to the consumer. These added benefits may be additional safety controls or indicators, environmental information indicators, shelf life indicators, authentication & tamper indicators, fashion accessories and/or fun & entertainment options. There are a number of patents in the field of thermochromic and fluorescent materials, however, many if not all of the patents disclosed suffer from certain drawbacks, such as providing entertainment only options, components that break down and deteriorate over time or under certain conditions, and a lack of versatility—from day to night, from rain to shine and from cold to hot, for example.

[0004] Thermochromic materials are those materials that change in color as the temperature rises or falls around the material. Reversible thermochromic materials that are negative working, that is, materials that change in color from a colored to a colorless state as temperature increases are disclosed in U.S. Pat. Nos. 4,028,118 and 4,717,770. Positive working thermochromic materials, that is, those materials that change from colorless to colored as the temperature is increased are disclosed in U.S. Pat. No. 4,421,560. Solvent-based formulations containing encapsulated thermochromic materials and methods of printing thereof are disclosed in U.S. Pat. No. 6,139,779. A disadvantage to utilizing thermochromic materials is that they are prone to photolytic degradation. U.S. Pat. No. 4,425,161 discloses the addition of certain cationic compounds to the thermochromic materials for enhancing their photolytic stability.

[0005] Fluorescent photochromic materials are those materials that are activated by light or radiation. Reversible fluorescent photochromic materials that are positive working, that is, materials which are colorless under ambient lighting conditions and colored in daylight (generally activated by ultra violet radiation), are disclosed in U.S. Pat. Nos. 3,562,172; 3,578,602; and 4,215,010. Reverse photochromic materials, are disclosed in U.S. Pat. No. 3,884,697. Methods for preparing printing inks using such materials are disclosed in U.S. Pat. No. 5,630,869. Photochromic materials are also subject to photolytic degradation causing light fatigue, that is, repeated exposure to light causes these materials to loose their photochromism. U.S. Pat. Nos. 3,212,898 and 3,666,352 teaches the use of UV absorbers alongside photochromic materials—the latter advocating the use of UV absorbers such as benzophenone with photochromic mercury thiocarbazonate materials to retard photolytic degradation.

[0006] Phosphorescent photochromic materials are often referred to as "glow in the dark" materials. Reversible phosphorescent photochromic materials are disclosed in U.S. Pat. Nos. 4,857,228 and 6,599,444. Such materials have been utilized in several consumer products to provide cosmetic, safety, or informational benefits to the consumer.

[0007] There are several patents that describe the use of the thermochromic, fluorescent or phosphorescent materials in various applications. U.S. Pat. No. 6,196,241 describes an umbrella where the fabric is treated with thermochromic or photochromic dyes to provide fashion benefits. For example, the umbrella can change colors during rain or when the sun comes out, depending on the dye utilized. However, there are no specific safety benefits or added environmental information indicators given that would indicate to the user weather conditions in advance of opening the umbrella.

[0008] U.S. Pat. No. 5,985,381 provides antidetection benefits by providing increased or decreased camouflage on clothing depending on thermal conditions. U.S. Pat. Nos. 4,130,760; 6,046,455 and 6,465,791 also disclose safety benefits by utilizing dosimeter embodiment for photochromic dyes.

[0009] U.S. Pat. No. 5,389,093 describes a diaper product that changes color because of temperature changes in the diaper caused by waste buildup in the diaper. The technology used to monitor the temperature changes in the diaper product is similar to that used in the '241 patent previously mentioned, i.e. the fabric is treated with a thermochromic dye.

[0010] The applications cited above have a single layer construction in that the color changing material is applied to the object in question as a single layer. Such embodiments can be rendered to create either a colored to colorless color change, or a colorless to colored color change, or a color change from one color to another. In the latter case, for the single layer embodiment there is a dye or pigment blended with the temperature or photo activated material. These single layer embodiments yield dull and darker colors and consequently lack the brightness to make the color change visually striking. Additionally, a single layer embodiment results in a non-robust image that is subject to scratches abrasion etc. Furthermore, the thermochromic dyes, specifically dyes based on electron donating and electron accepting materials such as those described in U.S. Pat. Nos. 4,028,118, 4,717,770 cited above, are subject to photolytic degradation. Similarly photochromic materials such as for example those cited in U.S. Pat. No. 3,562,172 are subject to light fatigue. One might consider that blending UV absorbers in with the chromic materials may be beneficial, but realistically blending these components is generally not an effective way to improve photolytic stability.

[0011] Based on the state of the art and the problems associated with various compounds and their uses, it would

be beneficial to have products which have color changing indicators based on thermochromic, fluroscent photochromic, phosphorescent photochromic compounds or a combination thereof that are constructed from a variey of substrate materials such as PVCacrylics, urethanes polyester, nylon etc. The substrate construction materials may be rigid or flexible. The color changing indicators previously mentioned are hereinafter referred to as "envirochromic materials" and can respond to environmental changes to provide at least one of the following: safety controls or indicators, environmental information indicators, fashion accessories, fun and entertainment options or a combination thereof.

[0012] In order to produce these products, one needs to develop a system construction such that the visual impact of the color change is striking, the indicator indicia are robust, the applied images patterns or indicia are photolytically stable and the product is not only durable for the user but also environmentally stable. One also needs to develop products that are desirable and useful to consumers in many fields of use, including food products, entertainment, sports, transportation, weather protection, decorating, indoor and outdoor sanitation or a combination thereof.

SUMMARY OF THE SUBJECT MATTER

[0013] A layered envirochromic material is described herein that contains at least one substrate or surface material; at least one base layer coupled to the at least one substrate or surface material; and at least one envirochromic layer coupled to the at least one base layer.

[0014] Methods of producing the layered envirochromic materials include providing a surface or substrate; applying at least one base layer component on to the surface; curing the at least one base layer component to form a base layer; applying at least one envirochromic layer component on to the surface; and curing the at least one envirochromic layer component to form the envirochromic layer.

[0015] Additional methods include providing a surface or substrate; applying at least one base layer component on to the surface; applying at least one envirochromic layer component on to the at least one base layer component; and curing the at least one base layer component and at least one envirochromic layer component to form the layered material.

DETAILED DESCRIPTION

[0016] New products have surprisingly been developed that address the problems associated with various compounds and their uses, including developing products which have color changing indicators based on thermochromic, fluroscent photochromic, phosphorescent photochromic compounds or a combination thereof and that are constructed from a variey of substrate materials such as PVCacrylics, urethanes polyester, nylon etc. The substrate or surface construction materials or components may be rigid or flexible. As mentioned in the Background Section, the color changing indicators disclosed and described herein are hereinafter referred to as "envirochromic materials" and can respond to environmental changes to provide at least one of the following: safety controls or indicators, environmental information indicators, fashion accessories, fun and entertainment options or a combination thereof.

[0017] A system construction has also been developed such that the visual impact of the color change is striking, the indicator indicia are robust, the applied images patterns or indicia are photolytically stable and the product is not only durable for the user but also environmentally stable. These new products are also desirable and useful to consumers in many fields of use, including food products, entertainment, sports, transportation, weather protection, decorating, indoor and outdoor sanitation or a combination thereof.

[0018] Specifically, in contemplated embodiments, a multilayer system construction or layered material has been designed so as to create a visually striking impact of the color change, to be durable with respect to scratches and abrasions and to have weatherometric robustness, such as photolytic stability and atmospheric stability for the indicator indicia or images.

[0019] The multilayered system construction and/or layered material can have at least two functional layers, and in some embodiments three or more functional layers, with each functional layer providing one or more specific functionalities or performing one or more specific functions, as described in detail below.

[0020] One contemplated embodiment comprises a three functional layer structure with a base layer providing functionality for maximizing or that maximizes the desired visual impact of the color change of at least part of the layered material, an envirochromic layer providing functionality for triggering a state change that is, either colorless to colored, or colored to colorless, or from one color to another, and a protective layer that provides functionality for handling and weatherometric robustness for the underlying image. The protective layer can also provide a visual enhancement function when desired by providing a reflective component or gloss for image viewing.

[0021] The base functional layer may produce the desired functionality either by a single or multiple layers of material, depending on the application and product. The base layer may be constructed either by blending the final color dye or pigment before fabrication of the layered material, such as by extrusion or molding or formation of plastic, glass, paper etc., or by a coating application process such as gravure, flexo, roll or blade coating etc., or by printing application processes such as screen printing or pad printing etc. One example of a base layer construction would to apply a layer containing a dye or pigment material including one or more fluorescent dyes or pigments that will render a brilliant final color. In this type of application, the envirochromic layer (applied on top of this layer) would generally function as an optical switch going from colored to colorless. This indicator could be accomplished by the base layer having the appropriate dye or pigment for the desired visual impact. Another application of a base layer construction is where the base layer contains just a white reflective pigment coating to maximze the color rendering of the envirochromic materials. In this type of application the envirochromic layer would go from either colorless to colored or from one color to another.

[0022] As stated earlier the base layer may also comprise multiple layers. An example of a two layer base functional layer is contemplated when the base layer is being applied to a rigid or flexible plastic or other material containing a strong absorbing color different from the final color. In such a case so as not to reduce final color impact or vibrancy, the

base layer will consist of a hidden layer consisting of a white reflective pigment application followed by the layer rendering the final color such as that described above.

[0023] There will be occasions where in order to create a visually striking final color, it may be necessary to first apply a specific contrasting color layer to enable striking visual impact of the final color. In such an embodiement, the base functional layer could become a three layer construction. In this case, one has to first create a desired oversized (oversized relative to final color image) contrast color image followed by a white reflective image followed by final color image application.

[0024] The base layer in addition to serving the function of enhancing the visual impact of the final color will also serve as a platform for the additional layers and/or functional layers. Therefore, it is important to consider the components of the base layer with respect to the components of additional layers in order to avoid color bleeding, undesirable chemical reactions between layers of materials and deterioration of the desired visual impact of the layered materials.

[0025] The second layer applied on top of the base layer will contain the envirochromic layer. The envirochromic layer may have one or more layers, where the layer or layers comprise at least one layer of envirochromic dyes, pigments or inks. Envirochromic dyes, pigments or inks are those that change color or texture with a changing environment, such as heat, cold, rain, sunshine, UV rays, snow, dark, light or a combination thereof. Envirochromic dyes, pigments or inks are contemplated to be those described herein earlier, conventional envirochromic dyes, pigments or inks, envirochromic dyes, pigments or inks that are yet to be developed or a combination thereof. Envirochromic inks, dyes and pigments may be clear until triggered, opaque until triggered or a particular color until triggered. Once triggered by an environmental condition, the ink, dye or pigment will change—whether it changes from clear to opaque or colored, from opaque to clear or colored or from colored to opaque or clear.

[0026] Contemplated envirochromic layers can be any suitable chromic layer, including thermochromic components, fluorescent photochromic components, phosphorescent photochromic components or a combination thereof. When phosphorescent photochromic materials or components are used, the base layer will generally be a white reflective pigment application. For example, when the color change is for the benefit of fun and entertainment and the object is to create a game of discovering hidden images that are revealed by a suitable trigger, the envirochromic layer will be oversized with respect to the top or final color-containing component of the base layer and further will be opaque or colored until triggered for a color change. This will enable the object to be hidden until it is discovered by activation.

[0027] As used herein, the term "fluorescence" or "fluorescent" means a type of luminescence in which an atom or molecule emits visible radiation in passing from a higher to a lower electronic state. The terms are restricted to phenomena in which the time interval between absorption and emission of energy is extremely short (10^{-8} to 10^{-3} second). This time interval distinguishes fluorescence from "phosphorescence", in which the time interval may be extended to several hours. The term "photochromic" means the characteristic of a transparent material to darken reversibly when exposed to light or the characteristic of a dark material or colored material to lighten or become transparent reversibly when exposed to light. (see Hawley's Condensed Chemical Dictionary, Twelfth Edition, Richard J. Lewis, Sr. (editor))

[0028] In some contemplated embodiments, the envirochromic layer will comprise photochromic phosphorescent materials, along with a resin/binder component, such that the total solid content of phosphor and resin is greater than at least 55% and in some other embodiments is greater than at least 75%. In other embodiments, the phosphor may be combined with a high extinction fluorescent absorber, such that the fluorescent absorber is activated by visible light during the daytime hours and by phosphor emission during night hours. In these embodiments, the phosphor and fluorescent absorber amounts are adjusted such that at nighttime there exists a phosphor emission peak as well as a phosphor excited emission peak of the fluorescent absorber to create night colors that are different from the phosphor color and to further create a nighttime palette of colors which emanate from adding the two spectra. In this embodiment, there may be no need for a base layer or a protective layer.

[0029] The envirochromic components may be diluted in appropriate solvents to form coating solutions and applied to various layers of materials in fabricating the layered materials contemplated herein. The coating solutions may be applied by any suitable method or process, including those already described herein. The envirochromic components and materials are designed to be readily integrated into existing layered materials or fabrication processes.

[0030] An optional third layer may be applied to the envirochromic layer. Contemplated third layers or additional layers will comprise an optically clear layer which, as is well known to those in the art, can be tailored to provide the requisite toughness for durability and weathering. Where necessary, such as for thermochromic materials and in certain cases for photochromic materials UV absorbers can be incorporated in the clear coat to provide photolytic stability.

[0031] Another contemplated embodiment comprises the use of two functional layers, one being the envirochromic layer and the other being the protective layer with functionality as described above. In yet another contemplated embodiment, the layered material may comprise two layers—a base layer and an envirochromic layer—where the envirochromic layer is tailored so that it comprises components that act as toughening agents or protectants.

[0032] Adhesion promoters may be added to any of the layers or materials that comprise the layered material in order to facilitate increased and durable adhesion and/or bonding of the coupled layers. Adhesion promoters may be added directly to the components that form the layer or may be added to one or more layers after curing and before the next layer is applied. As used herein, the term "coupled" means that the surface and layer or two layers are physically attached to one another or there's a physical attraction between two parts of matter or components, including bond forces such as covalent and ionic bonding, and non-bond forces such as Van der Waals, electrostatic, coulombic, hydrogen bonding and/or magnetic attraction. Also, as used herein, the term coupled is meant to encompass a situation where the surface and applied layer or layers are directly

attached to one another, but the term is also meant to encompass the situation where the surface and applied layer or layers are coupled to one another indirectly—such as the case where there's an adhesion promoter layer between the surface and applied layer or where there's another layer altogether between the surface and applied layer or layers.

[0033] Contemplated substrate materials may comprise virtually any substance upon which a compound can be deposited. For example, contemplated substrates include metals and non-metals, conductors and non-conductors, flexible and inflexible materials, absorbent and non-absorbent materials, flat and curved materials, textured and non-textured materials, solid and hollow materials, and both large and small objects. Viewed from another perspective, the wide breadth of contemplated substrates gives some indication of the scope of contemplated objects to which the present teachings may advantageously be applied. Methods and apparatus taught herein may also be used to produce less intricate surface coatings, or even full surface coatings such as might be employed in preparing reflective coatings for mirrors. Methods and apparatus described taught are especially useful for preparing full or partial surface coatings on curved surfaces, such as decorations on the sides of a motor vehicle.

[0034] It should be understood at this point that the term "layer" or "layers" as used herein refer to any and all layers formed and means any continuous layer or patterned layer. The patterns contemplated include any arrangement of points, dots, pictures, designs, whether isolated or combined to form lines, filled in spaces and so forth. Thus, some contemplated patterns include straight and curved lines, intersections of lines, lines with widened or narrowed areas, ribbons, overlapping lines. Other contemplated patterns include pictures and designs, such as logos, cartoon characters, game boards, letters, icons, symbols or another other suitable picture or design based on the product. Combinations of patterns are also contemplated.

[0035] The protective layer is applied to the, envirochromic layer or a combination thereof. The protective layer may comprise any coating that can protect the underlying layers from the environment and provide handling robustness. Protective layers may be clear or may contain pigment, UV absorbers, etc, so long as the underlying pigment and envirochromic dyes, inks or pigments can be viewed under certain conditions. Protective layers may also absorb UV rays.

[0036] Methods of producing a layered envirochromic component or material are described that include: a) providing a surface or substrate; b) applying at least one base layer component on to the surface; c) curing the base layer component to form a base layer; d) applying at least one envirochromic layer component on to the base layer; and e) curing the at least one envirochromic layer component to form the envirochromic layer. Each layer can be applied to the layered component and subsequently cured before additional layers are added or all layers can be applied to form the layered component and then the entire stack is cured at one time. In additional embodiments, once the base layer is cured, another group of base layer components may be applied and cured before the first layer of envirochromic components is applied. The same strategy is true for the envirochromic layer—meaning that once the envirochromic layer is cured, another group of envirochromic components may be applied and cured. In addition, protective components that will form a protective layer may be optionally applied to the cured envirochromic layers.

[0037] The components of the base layer, the envirochromic layer and/or the protective layer may be provided by any suitable method, including a) buying at least some of the base layer, the envirochromic layer and/or the protective layer from a supplier; b) preparing or producing at least some of the base layer, the envirochromic layer and/or the protective layer in house using chemicals provided by another source and/or c) preparing or producing at least some of the base layer, the envirochromic layer and/or the protective layer in house using chemicals also produced or provided in house or at the location.

[0038] For such applications, an ink jet type printer with head movement controlled in three dimensions may be used. Layers and/or coatings can be applied or deposited using otherwise ordinary printing equipment. Thus, embodiments disclosed herein may utilize an ink jet type dispenser, or a nib, while other embodiments may utilize a stamp or roller. Embodiments may also employ flexographic printing equipment, offset printing devices, silk screening, stamping or micro-stamping, and various spraying equipment. As mentioned above, it is contemplated that any printing or application process and equipment that uses inks can be employed effectively with embodiments of the present teachings. The ability to utilize such printing equipment not only lowers capital and production costs, but also greatly increases the speed at which deposits can be made on a substrate. The increase in speed is especially apparent when depositing complex patterns, or when depositing a plurality of different substances. In various embodiments of the present teachings, for example, an ink jet type dispenser could dispense different metal compounds as readily as it could dispense different color inks.

EXAMPLES OF APPLICATIONS

[0039] Applications of these novel layered materials are broad. For example, the layered materials described herein may be applied to an inflatable pool. Once applied to the inflatable pool, these layered materials can be utilized as entertainment (for e.g. to reveal hidden objects when touched by hand or exposed to high temperature, as a safety indicator (via a color change and/or either a cautionary sign when the water is too cold or a safe sign when water is at a comfortable temperature or when UV rays increase beyond normal safe levels), or as a fashion accessory (to show patterns or cartoon logos). For entertainment purposes, a Twister® or other game board could be created on the bottom of the pool. If the inflatable pool is large enough, the users of the pool could act as the "game pieces" in an underwater game of chess or checkers. The layered materials may also be designed as "chemical indicators". For example, if someone urinates in the pool, the inside of the pool will change colors, so that the water can be replaced before a health hazard develops.

[0040] Layered materials, as described herein, may be applied to golf balls in order to better find them underwater. For example, when a golf ball drops into a water hazard, it could change colors to a bright color, so that it can be easily spotted by the golfer. The golf ball can also comprise base

layers or envirochromic inks, dyes or pigments that glow in the dark for those golfers who play at night. Materials that may be utilized herein are described in U.S. Pat. Nos. 6,623,382, 6,358,160, 6,277,037, 5,938,544, 5,823,891, 5,774,997 and US Patent Application No.: 20040058753, all of which are commonly-owned by Performance Indicator and are incorporated herein in their entirety by reference.

[0041] Layered materials, as contemplated herein, may also be utilized as containers or wraps for food products. For example, a milk carton can be the basis of or part of the layered materials contemplated herein, and when the milk spoils, the carton changes colors or presents a caution icon. In other embodiments, layered materials may be used to wrap meats in supermarkets, in order to indicate to the consumer if the meat is fresh or spoiled. For food and dairy applications, the functional layers of material may be combined into one layer in order to provide a thinner and more useful wrap.

[0042] Layered materials, as contemplated herein, may also be applied as paints inside homes or commercial buildings. Paints utilized in this way may present a different color when the envirochromic dye, ink or pigment is exposed to carbon monoxide gas, volatile organic compound (VOC) contaminated air or a water leak. VOC contaminated air is common in buildings where the air supply is exposed to the fumes from a loading dock.

[0043] Layered materials, as contemplated herein, may be applied to utensils or china, such as plates, cups, bowls, etc., glasses or plastic storage containers. Layered materials utilized in this way can indicate to a consumer when something that's in the microwave is hot or when leftovers are spoiled. Layered materials can also be used with plastic containers or freezer bags to indicate when something is frozen or thawed.

[0044] Layered materials, as contemplated herein, may be used as automobile coatings or paints. Layered materials utilized in this manner could present or glow when cars are in the dark or in the rain/fog. This use would not only provide additional safety for the consumer, but also for other drivers and pedestrians on the road.

[0045] Layered materials, as contemplated herein, may be used in holiday decorations or ornaments in order to save electricity, meet homeowners' associations requirements for decorations, provide multiple images or decorations for a fraction of the cost of traditional decorations, etc.

[0046] Layered materials, as contemplated herein, may also be used to form labels or indicators on medical supplies, chemical supplies, pharmaceutical supplies and other supplies that may be adversely affected by the surrounding atmosphere. For example, a bottle of insulin may have a layered material such as those described herein applied as a label, so that when the conditions surrounding the bottle become such that the insulin is probably damaged or compromised that the patient or doctor is alerted. In this case, the label could turn from white to bright red when the temperature of the storage facility exceeds a particular and safe temperature. In another example, chemicals that are supposed to be kept dry and away from humidity could have labels or indicators that change to bright blue when the atmosphere has exceeded a particular humidity level—as is common in the southern and coastal states.

[0047] As shown, there are numerous opportunities for the use of the layered materials and imaging chemistries to indicate obsolescence, spoilage, loss of efficacy, safety, authentication, or tamper-evidence. There also exists an untapped niche market for utilizing color change to differentiate all types of household products with color change for either useful visual indication or simply fashion. These layered materials and imaging chemistries may be utilized on projects that include spoilage indicators for food containers (i.e., milk, deli meats, etc); tamper-evident/authentication indicators (e.g., U.S. Army soldiers' meals "MRE'S"); entertainment and safety features for inflatable pools and swim-related products; color change for adhesives that indicate cure; and novel systems for everyday consumer products such as shower curtains, cook ware, drink ware, and lawn ornaments.

[0048] Therefore, it should be obvious from all of the examples described herein that the layered materials described herein may be used on a broad range of applications. Specific embodiments and applications of layered envirochromic materials have been disclosed. It should be apparent, however, to those skilled in the art that many more modifications besides those already described are possible without departing from the inventive concepts herein. The inventive subject matter, therefore, is not to be restricted except in the spirit of the disclosure presented herein. Moreover, in interpreting the disclosure, all terms should be interpreted in the broadest possible manner consistent with the context. In particular, the terms "comprises" and "comprising" should be interpreted as referring to elements, components, or steps in a non-exclusive manner, indicating that the referenced elements, components, or steps may be present, or utilized, or combined with other elements, components, or steps that are not expressly referenced.

What is claimed is:

1. A layered material, comprising:

(a) at least one substrate or surface material;

(b) at least one base layer coupled to the at least one substrate or surface material; and

(c) at least one envirochromic layer coupled to the at least one base layer.

2. The layered material of claim 1, wherein the base layer comprises at least one layer of material or components.

3. The layered material of claim 2, wherein the base layer comprises at least one dye or pigment.

4. The layered material of claim 3, wherein at least part of the at least one dye or pigment is fluorescent.

5. The layered material of claim 3, wherein at least part of the base layer comprises a white reflective pigment.

6. The layered material of claim 1, wherein the envirochromic layer comprises at least one layer of envirochromic dyes, pigments or inks.

7. The layered material of claim 6, wherein the envirochromic dyes, pigments or inks comprise those dyes, pigments or inks that change color or texture with a fluctuating environment.

8. The layered material of claim 7, wherein the fluctuating environment comprises heat, cold, rain, sunshine, UV rays, snow, dark, light or a combination thereof.

9. The layered material of claim 1, wherein the envirochromic layer comprises at least one of a thermochromic

component, a fluorescent photochromic component, a phosphorescent photochromic component or a combination thereof.

10. The layered material of claim 1, further comprising at least one protective layer.

11. The layered material of claim 10, wherein the at least one protective layer is transparent.

12. The layered material of claim 10, wherein the at least one protective layer comprises pigment, UV absorbers or a combination thereof.

13. The layered material of claim 1 or claim 10 further comprising an adhesion promoter.

14. A method of producing a layered envirochromic material, comprising

(a) providing a surface or substrate;

(b) applying at least one base layer component on to the surface;

(c) curing the at least one base layer component to form a base layer;

(d) applying at least one envirochromic layer component on to the surface; and

(e) curing the at least one envirochromic layer component to form the envirochromic layer.

15. The method of claim 14, further comprising applying protective components that will form a protective layer to the cured envirochromic layers.

16. The method of claim 14, wherein the base layer comprises at least two layers of materials.

17. The method of claim 14, wherein the envirochromic layer comprises at least two layers of materials.

18. A method of producing a layered envirochromic component, comprising

(a) providing a surface or substrate;

(b) applying at least one base layer component on to the surface;

(c) applying at least one envirochromic layer component on to the at least one base layer component; and

(d) curing the at least one base layer component and at least one envirochromic layer component to form the layered material.

19. The method of claim 18, further comprising applying protective components that will form a protective layer to the cured layered material.

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