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(54) Authentication device

(57) This invention relates to an authentication device for an object (1), characterised in that the device comprises a sensor polymer (6) operable to change between a first state and a second state in response to an applied stimulus. The second state is different to the first state. In response to the stimulus being removed, the sensor polymer (6) reverts back to the first state.

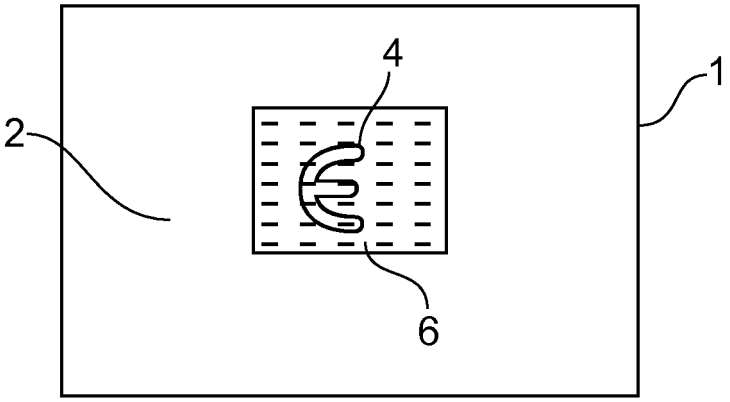

FIG. 1

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Description

Field of the Invention

[0001] The present invention relates to a device that is suitable for applying to or forming with an object, such as a banknote or other valuable and which is arranged to provide a form of authentication for the object.

Description of the Related Art

[0002] The manufacturers of banknotes and other high value objects, such as music, video or software compact discs, have to protect such items from illegal copying or counterfeiting. Such manufacturers have traditionally employed a number of devices in the manufacture of the banknote or high value object which are difficult for potential counterfeiters to replicate. Some of these devices are specifically designed such that members of the public are able to easily check the authenticity of the item to which the device has been affixed, or in some other way has been incorporated into the manufacture.

[0003] In particular, holograms have been used extensively as they were traditionally difficult to duplicate and members of the public could easily verify the authenticity of the hologram by simply viewing the 3D image.

[0004] A disadvantage with the use of holograms however is that holograms have become ubiquitous and low cost. They can, for example, be found on children's toys and other low cost retail products. The potential for a counterfeiter to acquire holograms for inclusion in a counterfeit banknote, or for inclusion in a counterfeit high value object, has therefore increased substantially in recent years.

[0005] In addition, despite extensive public awareness campaigns by banknote issuers and others, as to the authentication features deployed, the number of people actually checking such features is extremely low.

Summary of the Invention

[0006] According to a first aspect of the invention there is provided an authentication device for an object, characterised in that the device comprises a sensor polymer operable to change between a first state and a second state, different to the first state, in response to an applied stimulus and wherein in response to the stimulus being removed the sensor polymer reverts back to the first state.

[0007] It is therefore possible to provide a feature that can be incorporated into the manufacture of banknotes and other high value items which is able to undergo a reversible change when subjected to a specific stimulus or stimuli. The change may be visible and obvious to members of the public. In addition, or alternatively, the change or a further change may only be perceived by specialist devices, or be observable to trained personnel.

[0008] In a preferred embodiment, the sensor polymer changes opacity or colour between the first and second state. This results in the sensor polymer being operable to change between, for example, a masking state and a revealing state in response to an applied stimulus. Alternatively, or in addition, the sensor polymer may be operable to change between a hidden and revealed state in response to an applied stimulus. Alternatively, or in addition, the sensor polymer may change between different colours or different shades of the same colour.

[0009] Preferably the authentication device further comprises a location marker around or adjacent to the sensor polymer. The location marker may be a printed design, area of different texture or material to it's surroundings or other discernable feature. The location marker may serve to indicate the location of the sensor polymer and/or interact with the sensor polymer to form a design or feature. When the sensor polymer is generally transparent, and/or generally difficult to see or identify from the background or area around it, the location marker may indicate the area of the object where the sensor polymer is located.

[0010] Advantageously the authentication device further comprises an authentication feature at least partially covered by the sensor polymer, such that changing between the first and second states masks or reveals at least part of the authentication feature. Preferably, the area defined by the sensor polymer is small in comparison with the area defined by the authentication feature. The authentication feature may comprise an area of colour print. A purpose of the authentication feature is to provide some form of mark that is discernable from another part of the authentication device and/or object, such that stimulation of the sensor polymer reveals the authentication feature. The authentication feature can be an area of different colour or texture to the area around it, so as to be discernable upon the sensor polymer being excited by an external stimulus.

[0011] Preferably the sensor polymer comprises a thermochromic polymer. This enables heat to be the stimulus, which is available to a wide range of users. For example, a person may stimulate the sensor polymer by the heat from a body part, such as a finger or thumb. Alternatively, or in addition, the sensor polymer may comprise a chromogenic polymer, such as a photochromic, electrochromic, piezochromic, ionochromic or biochromic polymer. Two or more types of sensor polymer may be used in combination, meaning that two types of stimulus are required to cause the authentication device to reveal the authentication feature.

[0012] According to a second aspect of the invention, there is provided an object including an authentication device according to the first aspect of invention.

[0013] The object may have the authentication device applied to it, by some fixing means such as adhesive. Preferably the authentication device is integrally formed with the object during manufacture of the object.

[0014] According to a third aspect of the invention, there is provided a method of checking the authenticity

of an object having an authentication device comprising a sensor polymer, the method including the steps of:

applying a stimulus to the sensor polymer, thereby causing the sensor polymer to change between a first state and a second state different to the first state; and

verifying the object as authentic or not depending upon the presence and function of the sensor polymer, whereby the sensor polymer reverts back to the first state upon the stimulus being removed.

Brief Description of the Drawings

[0015] The invention will now be described, by way of example only with reference to the accompanying drawings, in which:

Figure 1 is a schematic drawing of a banknote incorporating an authentication device and constituting a first embodiment of the invention, without applied stimulus;

Figure 2 is a schematic drawing of the banknote of Figure 1 upon exposure to a stimulus;

Figure 3 is a schematic drawing of a banknote incorporating an authentication device and constituting a second embodiment of the invention without applied stimulus; and

Figure 4 is a schematic drawing of the banknote at Figure 3 upon exposure to a stimulus.

Description of Preferred Embodiments

[0016] Referring to Figure 1 of the accompanying drawings, an object 1 is shown having associated with it an authentication device generally designated 2 representing a first exemplary embodiment of the invention. The object 1 may be a valuable object, such as a bank note, compact disc (CD) or the like, to which it is desirable to attach, apply or integrally form an authentication device that serves to identify the object as authentic.

[0017] The authentication device in this embodiment comprises an authentication feature 4 which is a visually apparent feature, such as a printed letter, number or picture. The authentication feature is visually distinguishable from another part of the object 1 such that, it may be noticed by a person or viewing device when in a revealed state. The authentication feature 4 is at least partially covered, and preferably fully covered, by a sensor polymer 6. In this embodiment, the authentication feature 4 comprises a feature that is printed onto a face of the object 1 and overlaid with the sensor polymer 6. This can be done during manufacture of the object 1 or at a later date.

[0018] The sensor polymer 6 is operable to change between a first state and a second state in response to a stimulus or stimuli (hereinafter referred to as "stimulus"). Upon removal of the stimulus the sensor polymer 6 reverts back to the first state. The sensor polymer 6 may change between more that two states in response to different types or levels of stimulus. The sensor polymer in this exemplary embodiment comprises a chromogenic polymer that, upon application of stimulus, changes between an opaque state, such as a colour, and a substantially transparent or translucent state. Therefore, when no stimulus is incident upon or applied to the sensor polymer 6 it at least partially covers the authentication feature 4 such that the authentication feature 4 cannot easily be recognised or seen by a person or other viewing means looking at the object 1. A person skilled in the art will appreciate that chromogenic polymers change their visible optical properties in response to external stimulus. For more information on certain sensor polymers the skilled person is directed to "The Encyclopedia of Polymer Science and Technology, Vol. 12, Thermochromic Polymers 143". Some examples of suitable thermochromic polymers are Cholesteric Liquid Crystalline Polymers, Conjugated Polymers and Thermotropic Polymer Gels, such as poly(ethylene glycol) (PEG)/PVA/Borax hydrogels. For the latter, the clearing temperature can be shifted between approximately 15°C and 90°C, depending upon the concentration of both polymers, their molecular masses and the degree of cross linking. For example, this thermochromic sensor polymer containing PEG with a molecular mass of 20,000 changes its transparency within a temperature range of a few degrees and with a molecular mass of 70,000 changes its transparency within a temperature range of around 30°C to 40°C.

[0019] Upon application of stimulus to the sensor polymer 6, as shown in Figure 2, it changes from an opaque state to a transparent state, thereby revealing the parts of the authentication feature 4 present between the sensor polymer 6 and the object 1. Thus, a person can stimulate the authentication device to check that the object 1 is authentic.

[0020] The sensor polymer 6 chosen for the authentication device may react (i.e. change between states) in response to a range of stimulus.

[0021] The activation stimulus may include heating the sensor polymer 6, for example through a person's touch or by any suitable heat source (a polymer that reacts to this type of stimulus is classified as a thermochromic polymer). Pressure could be used as a stimulus (classified as a piezochromic polymer), or electricity (classified as an electrochromic polymer). Other stimuli include applying a material such as a chemical or ion concentration or biochemical material to the sensor polymer 6. Where the sensor polymer 6 is responsive to a material or the like, the stimulus could be exclusive and provided to specific persons such that they may be able to check authenticity. For, example, the exclusive stimulus could comprise a specific protein which may be specifically manufactured.

[0022] Other potential stimuli include electromagnetic

energy, for example visible, infrared or ultraviolet light (a polymer that reacts to this type of stimulus is classified as a photochromic polymer).

[0023] The skilled person will therefore appreciate that a suitable sensor polymer can be chosen for the authentication device depending upon the desired stimulus type. For example, by designing the sensor polymer 6 to change states in response to body heat, or pressure, a wider range of persons can authenticate the object. Conversely, by choosing a sensor polymer 6 that only reacts to a specific uncommonly owned and/or known stimulus (e.g. a specific protein), then the ability to check the authenticity of the object is more exclusive.

[0024] Referring now to Figures 3 and 4, an object 1 is shown having associated with it an authentication device 8 constituting a second exemplary embodiment of the invention. In this embodiment, the authentication device comprises a sensor polymer 10 which in its un-stimulated state is substantially transparent, translucent or opaque and in response to an applied stimulus, such as those described with reference to the first exemplary embodiment, the sensor polymer 10 changes to a viewable state, or different viewable state, and thus forms the authentication feature. The viewable state may be the sensor polymer 10 changing to a colour, such as black. The sensor polymer 10 is formed in a shape such as number, letter, or picture, that is to some degree visually apparent to a person or viewing device viewing the part of the object where the sensor polymer 10 is located.

[0025] To aid a person in applying stimulus to the correct part of the object 1, a location marker 12 may be provided around or adjacent the sensor polymer 10. The location marker 12 is visible without a stimulus being applied to it and can comprise a material unresponsive to the chosen stimulus. Alternatively, the location marker 12 may comprise a similar sensor polymer to that of the first embodiment such that it becomes transparent when the sensor polymer 10 is stimulated. The location marker 12 and sensor polymer 10 could together form the authentication feature. For example the location marker 12 may form a part of the authentication feature and the sensor polymer 10 may form a cooperating part that only becomes apparent when stimulated. Alternatively, the location marker may form part of the authentication feature with the sensor polymer 10 forming a cooperating part such that the authentication feature only becomes apparent when stimulated. An example of this would be the sensor polymer 10 forming on half of a circle and the location marker 12 forming the other half of the circle, such that stimulation results in a full circle of predefined properties being displayed.

[0026] The object 1 may have information printed on it identifying the type of stimulus the sensor polymer 6, 10 is responsive to.

[0027] In use, a person receiving an object 1 and wishing to verify the authenticity thereof may identify the type of stimulus that the sensor polymer is responsive to, say heat, and apply the stimulus accordingly to the appropriate area. Doing so will result in the sensor polymer 6, 10 changing from the first to second state, thereby revealing the authentication feature. Upon removal of the stimulus the sensor polymer reverts back to the first state. This may be after a predetermined period, in order to give ample opportunity for the source of the stimulus to be removed from a user's field of view of the sensor polymer before it reverts back to the first state. If the sensor polymer is included with the object 1 and performs or operates as expected, the user can verify that it is likely the object 1 is authentic.

[0028] Each of the first and second exemplary embodiments have an authentication feature that is apparent to a person viewing the part of the object 1 where the sensor polymer 6 or sensor polymer 10 is located, when stimulated. However, the authentication feature may be more subtle, such that it is unlikely to be perceived by a person viewing the object and may, for example, require an machine vision imaging system such as a charge coupled device (CCD) camera in combination with a computer or microcontroller running machine vision software for comparing the authentication device in un-stimulated and stimulated states. In this case, the area of sensor polymer 6, 10 may be small in comparison with the area defined by either the authentication feature or the area defined by the location marker or other constantly-visible feature. For example, the sensor polymer 6 changing between states could result in a small change to a complex design, or a subtle change in its colour. The latter could be resolved by spectroscopy.

[0029] It will be appreciated that the invention provides a solution which involves features incorporated into the manufacture of a bank note or other object or item of value, or features which can be applied to an object after it has been manufactured, the features being designed to change their characteristics upon exposure to physical or non-physical stimulus. This provides of an effective authentication system that is difficult to counterfeit. Furthermore, the feedback nature of the authentication process in some embodiments may encourage the public to make greater use of the authentication device that with prior art systems.

Claims

1. An authentication device for an object (1), **characterised in that** the device comprises a sensor polymer (6, 10) operable to change between a first state and a second state, different to the first state, in response to an applied stimulus, and wherein in response to the stimulus being removed, the sensor polymer (6, 10) reverts back to the first state.

2. An authentication device according to claim 1, wherein the sensor polymer (6, 10) changes opacity or colour between the first and second state.

3. An authentication device according to any preceding claim, further comprising a location marker (12) around or adjacent the sensor polymer (6, 10).

4. An authentication device according to claim 2, further comprising an authentication feature (4) at least partially covered by the sensor polymer (6, 10), such that changing between states masks or reveals at least part of the authentication feature.

5. An authentication device according to claim 4, wherein the area defined by the sensor polymer (6, 10) is small in comparison with the area defined by the authentication feature (4).

6. An authentication device according to any preceding claim, wherein the sensor polymer (6, 10) comprises a thermochromic polymer.

7. An authentication device according to any of claims 4 to 6 wherein the authentication feature (4) is an area of colour print.

8. An object (1) including an authentication device according to any of claims 1 to 7.

9. A method of checking the authenticity of an object having an authentication device comprising a sensor polymer, the method including the steps of:

applying a stimulus to the sensor polymer, thereby causing the sensor polymer to change between a first state and a second state different to the first state; and
verifying the object as authentic or not depending upon the presence and function of the sensor polymer, whereby the sensor polymer reverts back to the first state upon the stimulus being removed.

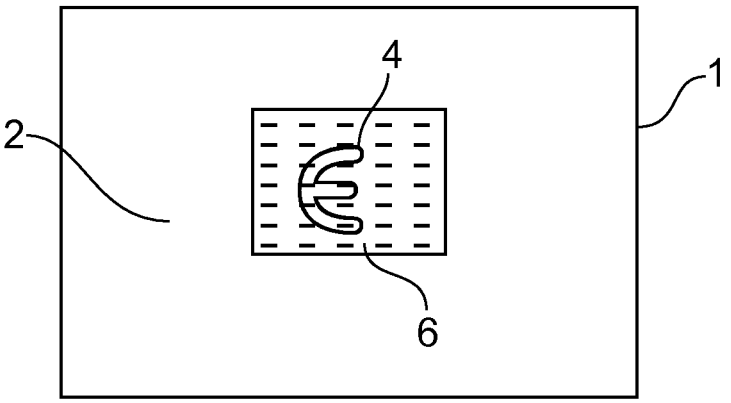

FIG. 1

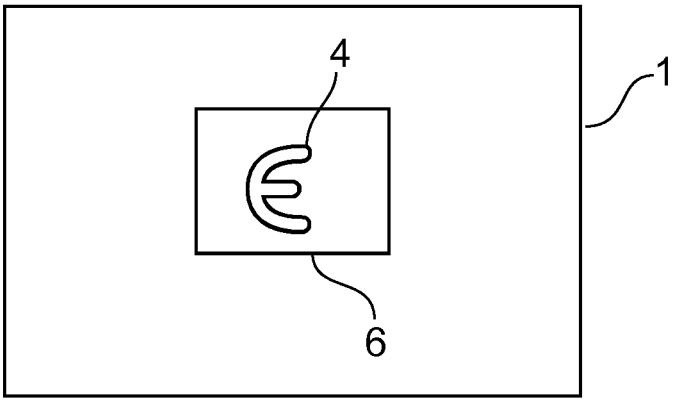

FIG. 2

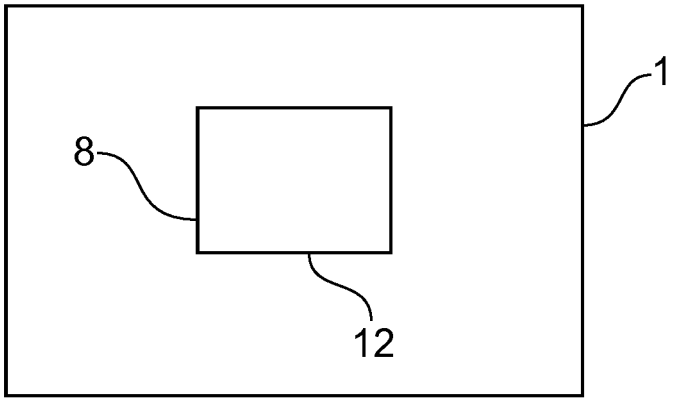

FIG. 3

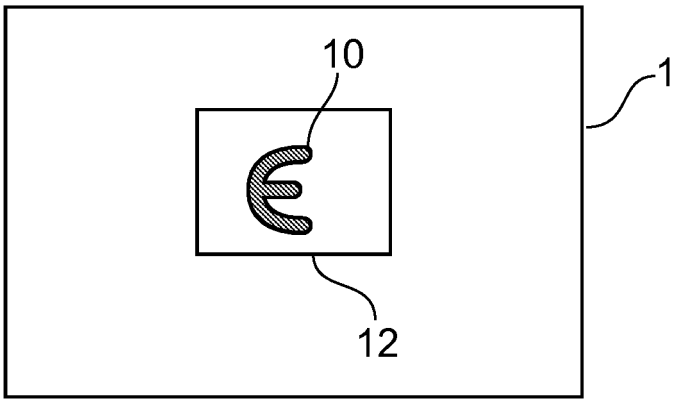

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 08 15 8049

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	FR 2 698 390 A (ARJO WIGGINS SA [FR]) 27 May 1994 (1994-05-27) * page 3, line 33 - page 4, line 33 * * page 5, line 4 - page 6, line 8 * * page 7, line 8 - page 8, line 33 * * page 12, lines 8-16 * * figures 1,2 * -----	1-9	INV. G07D7/14
X	EP 1 475 766 A (NHK SPRING CO LTD [JP]) 10 November 2004 (2004-11-10) * paragraphs [0006] - [0013] * * paragraphs [0018] - [0020] * -----	1-9	
X	US 5 826 915 A (GREGORY VANCE P JR [US] ET AL) 27 October 1998 (1998-10-27) * column 1, lines 23-38 * * column 1, line 66 - column 2, line 36 * * figures 1-5 * -----	1-9	
X	US 5 193 854 A (BOROWSKI JR JOSEPH C [US] ET AL) 16 March 1993 (1993-03-16) * column 3, lines 9-35 * * column 3, lines 60-68 * * column 4, line 61 - column 5, line 16 * * figures 1-3 * -----	1-9	

TECHNICAL FIELDS SEARCHED (IPC)

G07D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 October 2008	Espuela, Vicente

CATEGORY OF CITED DOCUMENTS

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1

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 15 8049

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Non-patent literature cited in the description

- The Encyclopedia of Polymer Science and Technology, Vol. 12, Thermochromic Polymers. vol. 12, 143 **[0018]**