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- Published:**
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(54) **Title:** ULTRAVIOLET-DULL RESPONSE IN SECURITY TAGGANTS

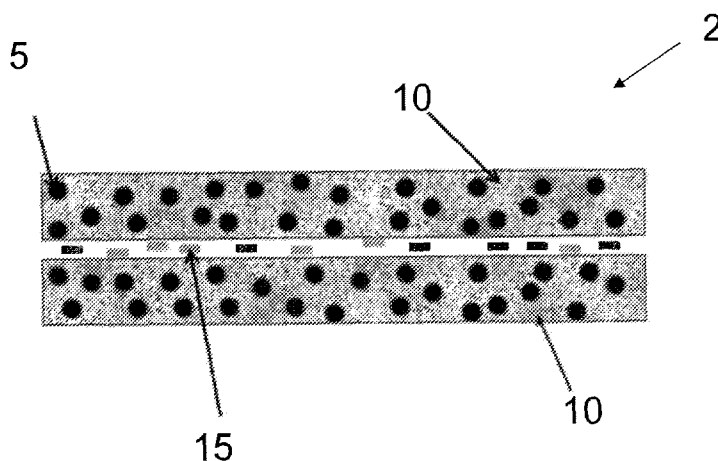


FIG 1.

(57) **Abstract:** Articles and methods for manufacturing security articles include ultraviolet absorptive materials disposed above and below an emissive security taggant that prevent excitation of the taggant itself at certain shorter ultraviolet wavelengths, rendering the article secure from detection by normal or conventional means.

Ultraviolet-Dull Response in Security Taggants**Cross-Reference to Related Applications**

This application claims the benefit of U.S. Provisional Application No.
5 61/184,586, filed on June 5, 2009, the entire disclosure of which is incorporated by
reference herein.

Field of Invention

[0001] The present invention relates to security articles, and more specifically to
security articles having a substrate constructed with materials that exhibit an
10 ultraviolet fluorescence or phosphorescence emission.

Background

[0002] Counterfeiting of documents such as passports, stock certificates, and
banknotes is a serious problem in modern economies. Large scale counterfeiting is
often financed by well funded organizations such as foreign governments and
15 terrorist organizations. Counterfeiting activity poses threats to both economic
stability and national security.

[0003] Public security features are usually aimed at preventing smaller scale, less
sophisticated counterfeiting, while covert machine readable features known only to
central banks or border control authorities are the main deterrent to sophisticated
20 large scale efforts. Typically these features are required to be undetectable as well
as extremely difficult to reproduce.

[0004] What is needed, therefore, is a security article such as a banknote or other
secure document having a substrate constructed to allow for the use of materials that
exhibit an ultraviolet fluorescence or phosphorescence to be employed without

having this emission detectable by normal or conventional means, but rather by simple visual inspection under an appropriate ultraviolet illumination source only.

Summary

[0005] Embodiments of the invention include articles and methods for
5 manufacturing security articles. Ultraviolet absorptive materials disposed above and below an emissive security taggant prevent the excitation of the taggant itself at certain shorter ultraviolet wavelengths, rendering the document secure from detection by normal or conventional means.

[0006] According to one embodiment of the invention, a security article includes a
10 first substrate comprising an ultraviolet absorptive material and an emissive taggant excitable by ultraviolet radiation. The taggant may be disposed in the substrate and blocked by at least a portion of the ultraviolet absorptive material. The ultraviolet absorptive material prevents emission of the taggant upon application of substantially short ultraviolet wavelengths.

15 [0007] Another embodiment of the invention includes a method of manufacturing a security article in which a first substrate is embedded with an ultraviolet absorptive material. An emissive taggant excitable by ultraviolet radiation is also embedded within the substrate. The taggant is blocked by at least a portion of the ultraviolet absorptive material. The ultraviolet absorptive material prevents emission of the
20 taggant upon application of substantially short ultraviolet wavelengths.

[0008] Yet another embodiment of the invention includes an ultraviolet-dull response structure having a first substrate and a second substrate. Each of the

substrates include an ultraviolet absorptive material. An emissive taggant excitable by ultraviolet radiation is disposed between the first substrate and the second substrate. The ultraviolet absorptive material prevents emission of the taggant upon application of ultraviolet wavelengths less than about 400nm.

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Brief Description of the Drawings

[0009] The present invention will be more readily understood from a detailed description of the preferred embodiments taken in conjunction with the following figures:

FIG. 1 depicts a cross-sectional view of a security document in accordance with an embodiment of the present invention; and

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FIG. 2 illustrates a method of creating a secure document in accordance with an embodiment of the invention.

Detailed Description

[0010] Throughout the application, where compositions are described as having, including, or comprising specific components, or where processes are described as having, including or comprising specific process steps, it is contemplated that compositions of the present teachings also consist essentially of, or consist of, the recited components, and that the processes of the present teachings also consist essentially of, or consist of, the recited process steps.

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[0011] In the application, where an element or component is said to be included in and/or selected from a list of recited elements or components, it should be

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understood that the element or component can be any one of the recited elements or components and can be selected from a group consisting of two or more of the recited elements or components. Further, it should be understood that elements and/or features of a composition, an apparatus, or a method described herein can be combined in a variety of ways without departing from the spirit and scope of the present teachings, whether explicit or implicit herein.

[0012] The use of the terms “include,” “includes,” “including,” “have,” “has,” or “having” should be generally understood as open-ended and non-limiting unless specifically stated otherwise.

[0013] The use of the singular herein includes the plural (and vice versa) unless specifically stated otherwise. Moreover, the singular forms “a,” “an,” and “the” include plural forms unless the context clearly dictates otherwise. In addition, where the use of the term “about” is before a quantitative value, the present teachings also include the specific quantitative value itself, unless specifically stated otherwise.

[0014] It should be understood that the order of steps or order for performing certain actions is immaterial so long as the present teachings remain operable. Moreover, two or more steps or actions may be conducted simultaneously.

[0015] According to one embodiment of the invention, the optical or ultraviolet excitation of taggants such as fibers and other security features, which exhibit emissions under excitation by ultraviolet or other wavelengths, can be suppressed by placing the taggants within a region which lies inside or within one or two (for double sided suppression) other regions void of such materials. These void regions

prevent the excitation light at shorter wavelengths from reaching the emissive materials through a combination of scattering and absorption. The scattering is preferential to shorter wavelengths, and in the case of Rayleigh scattering, exhibits a λ^{-4} dependence, where λ is the wavelength. Shorter wavelengths less than about 400 nanometers (nm) are expected to experience a six-fold (6x) increase in scattering as compared to wavelengths in the 600 nm range. This allows longer wavelength-response taggants from about 400 nm to about one micron to be interrogated by sensors while remaining dull to ultraviolet excitation. This strong dependence on wavelength favors the transmission of longer wavelengths, allowing for the interaction of other wavelengths with the taggant materials within the suppression region. In addition, according to one embodiment, the construction of a document can utilize additional materials or particles, which absorb undesirable excitation wavelengths, such as the ultraviolet excitation as is common in public security features. The absorptive materials may be organic materials, such as common ultraviolet absorbers, inorganic materials, such as TiO_2 , semiconductor nanocrystals, or other oxides such as ZnO .

[0016] Figure 1 depicts a cross-sectional view of a secure document 2 in accordance with an embodiment of the invention. Two scattering substrate layers 10 (e.g., paper) surround or incorporate a layer of taggant materials 15. The substrate layers 10 include particles 5 having absorptive properties in the ultraviolet or other specific wavelength ranges. The taggant materials 15 may include fibers, planchettes, or threads. The absorptive particles prevent excitation light at shorter wavelengths from reaching the emissive taggant materials contained in the substrates 10. Examples of emissive materials may include, without limitation,

ultraviolet-infrared phosphors, upconverting materials, fluorescent dyes, and quantum dots.

[0017] As an additional public security feature, in one embodiment, emissive taggants, which respond to ultraviolet excitation, can be incorporated in a single layer structure whereby the fluorescence can be activated from one side of the document and not the other.

[0018] According to one embodiment, banknotes or other secure documents utilizing a double or single sided ultraviolet-dull response can be constructed by either localizing the pulp layer with the taggant in the center of the note during the forming process or through a multilayer construction process with two or three layers being pressed together to form the final substrate or document paper.

[0019] Figure 2 illustrates a method 200 of manufacturing a secure document. According to the illustrated method, a substrate 210 is embedded 220 with ultraviolet absorptive materials. An ultraviolet emissive taggant is also embedded 230 beneath a portion of the substrate and the plurality of ultraviolet absorptive particles. Upon application of substantially short ultraviolet wavelengths to the document 240, the absorptive materials prevent emission of the taggant at those wavelengths. Only upon application or excitation of the document by a longer wavelength source will a responsive emission be detected.

[0020] While embodiments of the invention described herein use ultraviolet absorptive and emissive materials to form a security article, one skilled in the art should recognize that other materials that exhibit similar behaviors under different

excitation sources may be used, such as absorptive and emissive materials in the visible light spectrum, the infrared spectrum, and other electromagnetic radiation.

[0021] While the invention has been described with reference to illustrative embodiments, it will be understood by those skilled in the art that various other changes, omissions and/or additions may be made and substantial equivalents may be substituted for elements thereof without departing from the spirit and scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims. Moreover, unless specifically stated any use of the terms first, second, etc. do not denote any order or importance, but rather the terms first, second, etc. are used to distinguish one element from another.

Claims

What is claimed is:

1. A security article comprising:
a first substrate comprising a first ultraviolet absorptive material; and
5 an emissive taggant excitable by ultraviolet radiation disposed in the first substrate and blocked by at least a portion of the first ultraviolet absorptive material of the first substrate;
wherein the ultraviolet absorptive material prevents emission of the taggant upon application of substantially short ultraviolet wavelengths.
- 10 2. The security article of claim 1 wherein the substantially short ultraviolet wavelengths are wavelengths less than about 400 nm.
- 3 The security article of claim 1 wherein the first ultraviolet absorptive material is formed as a layer in the first substrate to block the taggant.
4. The security article of claim 1 wherein the taggant is selected from the group
15 consisting of fibers, planchettes and threads.
5. The security article of claim 1 wherein the first ultraviolet absorptive material comprises an inorganic material.
6. The security article of claim 5 wherein the inorganic material is selected from the group consisting of TiO₂, ZnO, semiconductor nanocrystals and oxides.

7. The security article of claim 1 wherein the first ultraviolet absorptive material comprises a plurality of particles.
8. The security article of claim 1 where in the first ultraviolet absorptive material comprises an organic material.
- 5 9. The security article of claim 1 further comprising a second substrate comprising a second ultraviolet absorptive material, wherein the taggant is blocked by at least a portion of the second ultraviolet absorptive material of the second substrate.
- 10 10. The security article of claim 9 wherein the first ultraviolet absorptive material and the second ultraviolet absorptive material are the same ultraviolet absorptive material.
11. The security article of claim 1 where in the taggant is selected from the group consisting of ultraviolet-infrared phosphors, upconverters, fluorescent dyes, and quantum dots.
- 15 12. A method of manufacturing a security article comprising:
embedding a first ultraviolet absorptive material in a first substrate; and
embedding an emissive taggant excitable by ultraviolet radiation within the first substrate and blocked by at least a portion of the first ultraviolet absorptive material of the first substrate, the first ultraviolet absorptive material preventing
20 emission of the taggant upon application of substantially short ultraviolet wavelengths.

13. The method of claim 12 wherein the substantially short ultraviolet wavelengths are wavelengths less than about 400 nm.
14. The method of claim 12 wherein the taggant is selected from the group consisting of fibers, planchettes and threads.
- 5 15. The method of claim 12 wherein the first ultraviolet absorptive material comprises inorganic materials.
16. The method of claim 12 wherein the ultraviolet absorptive material comprises organic materials.
17. The method of claim 12 wherein the embedding the first ultraviolet
10 absorptive material in the first substrate comprises forming the first ultraviolet absorptive material as a layer in the first substrate to block the taggant.
18. The method of claim 12 further comprising applying a second substrate, the second substrate comprising a second ultraviolet absorptive material, wherein the taggant is blocked by at least a portion of the second ultraviolet absorptive material
15 of the second substrate.
19. An ultraviolet-dull response structure comprising:
a first substrate and a second substrate, each comprising an ultraviolet absorptive material; and
an emissive taggant excitable by ultraviolet radiation disposed between the
20 first substrate and the second substrate, the ultraviolet absorptive material preventing

emission of the taggant upon application of ultraviolet wavelengths less than about 400 nm.

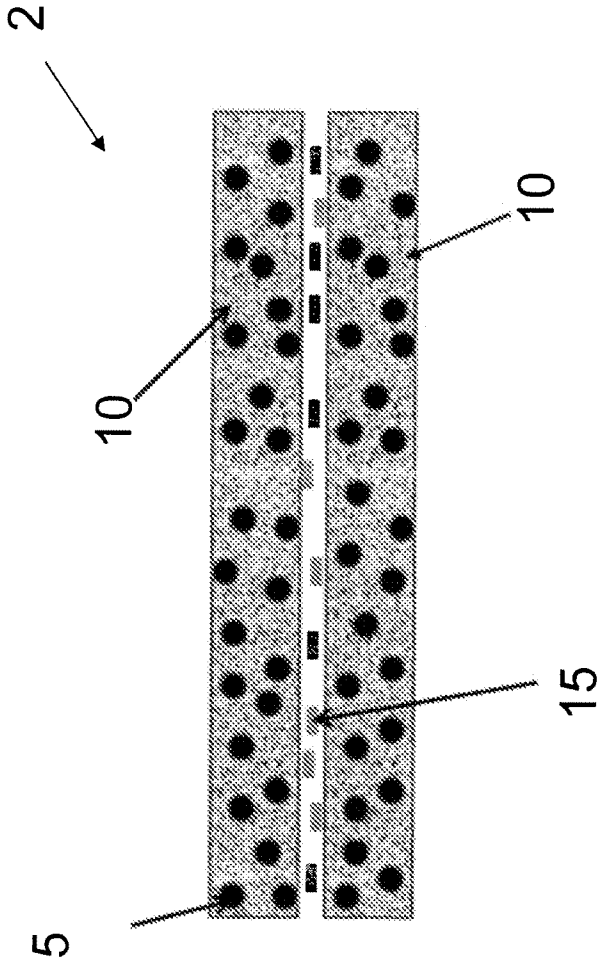


FIG 1.

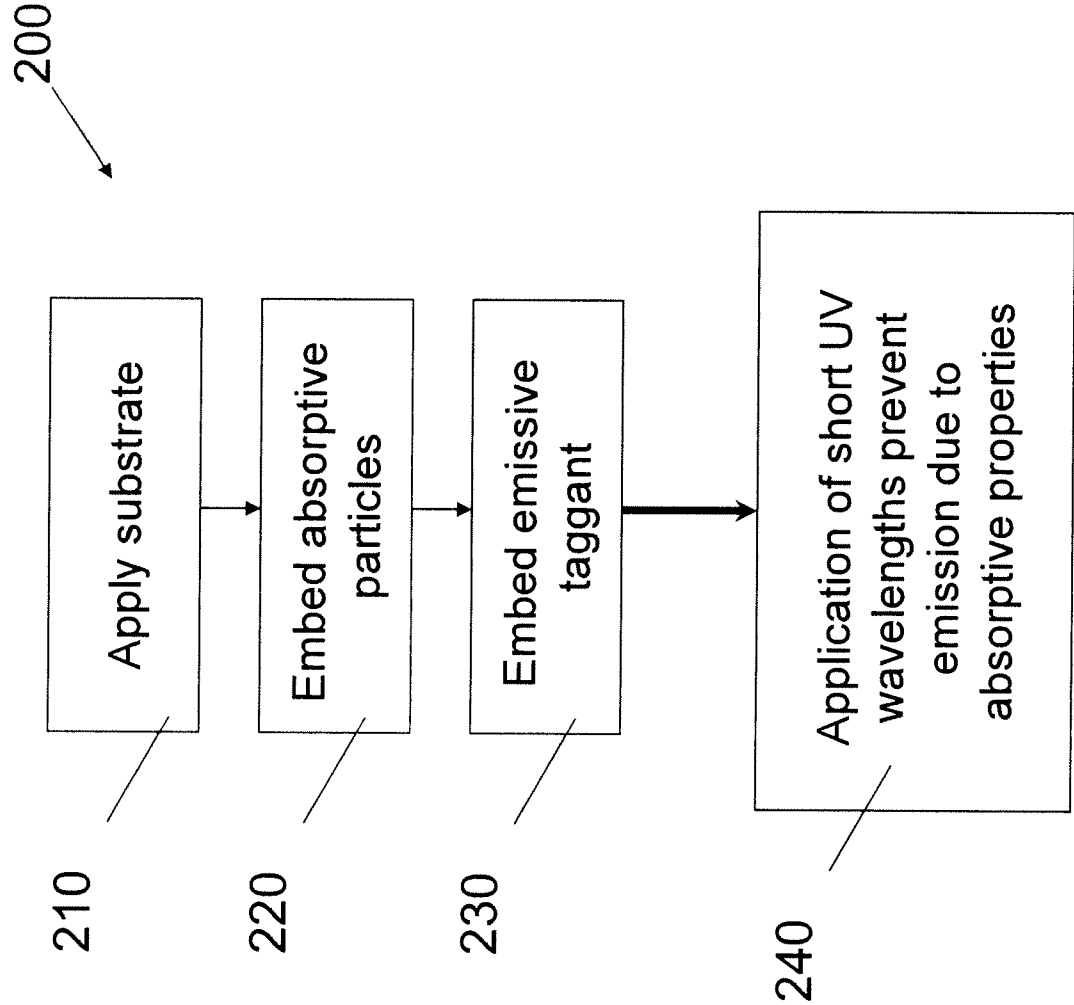


FIG 2.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 10/37476

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - C09D 11/00 (2010.01)

USPC - 106/31.14; 523/161

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) -- C09D 11/00 (2010.01)

USPC -- 106/31.14; 523/161

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

IPC(8) -- G01N5; B41M35; G01N215; G01N235; G09F35 (2010.01)

USPC -- 283/85; 235/375; 340/572.1; 705/64

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PubWest (PGPB,USPT,USOC,EPAB,JPAB); USPTO; Espacenet; Google Patents; Google Scholar; Google -- please see extra sheet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2008/0129036 A1 (Seki et al.) 05 June 2008 (05.06.2008) Figs 1-3; Figs 15 and 16; para [0017]; [0092]; [0096]; [0098]; [0113]; [0119]; [0120]	1-19
Y	US 2003/0111641 A1 (Webster) 19 June 2003 (19.06.2003) para [0086]; [0100]; [0105]; [0127];	1-19
Y	US 2007/0034833 A1 (Parce et al.) 15 February 2007 (15.02.2007) para [0011]; [0014]; [0018]; [0024]; [0099]	11,17,18,19
Y	US 2007/0262294 A1 (Peterson et al.) 15 November 2007 (15.11.2007) Fig 2; para [0004]; [0016]	18,19
A	US 2008/0138641 A1 (Leenders et al.) 12 June 2008 (12.06.2008) para [0053]; [0061]; [0063]; [0066]; [0107]; [0111]; [0123]; [0124]; [0163]	1-10,12-16
A	US 2007/0119951 A1 (Auslander et al.) 31 May 2007 (31.05.2007) Figs 1A, 1B, 1C; Fig 2; Fig 3; para [0037]; [0044]; [0047]; [0061]; [0062]	1-19
A	US 2006/0262367 A1 (Hattori et al.) 23 November 2006 (23.11.2006) Figs 2 (a) - (h); para [0048]; [0253]	1-19



Further documents are listed in the continuation of Box C.



* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

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Date of mailing of the international search report

10 AUG 2010

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 10/37476

Search Terms Used:

ABSORPT\$ ABSORB\$ PREVEN\$ QUANTUM DOT SCATTER\$ SEMICONDUCTING NANOCRYSTAL\$ SUPPRESS\$ TAGGANT
UPCONVERT\$ OR UP-CONVERT\$ UV-ABSORBER

AUTHENTIC\$ OR BANKNOTE\$ OR COUNTERFEIT\$ OR COUNTER-FEIT\$ OR FORGE\$ OR SECURIT\$

(DYE) NEAR10 FLUORESC\$

FLUORESC\$ OR LUMINESC\$ OR PHOSPHOR\$

FIBER OR FILAMENT OR PLANCHETTE OR RIBBON OR THREAD

LAYER OR MULTILAYER\$ OR MULTI-LAYER\$ OR SUBSTRATE

EMISSION OR EMISSIV\$ OR EMIT OR EMITT\$ OR TRANSMIT\$

UV OR ULTRAVIOLET OR ULTRA-VIOLET

ZnO OR TiO2 OR ZINC OXIDE OR TITANIA OR TITANIUM DIOXIDE