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[Continued on next page]

(54) Title: SOLID-STATE LIGHT EMITTING DEVICES AND SIGNAGE WITH PHOTOLUMINESCENCE WAVELENGTH CONVERSION AND PHOTOLUMINESCENT COMPOSITIONS THEREFOR

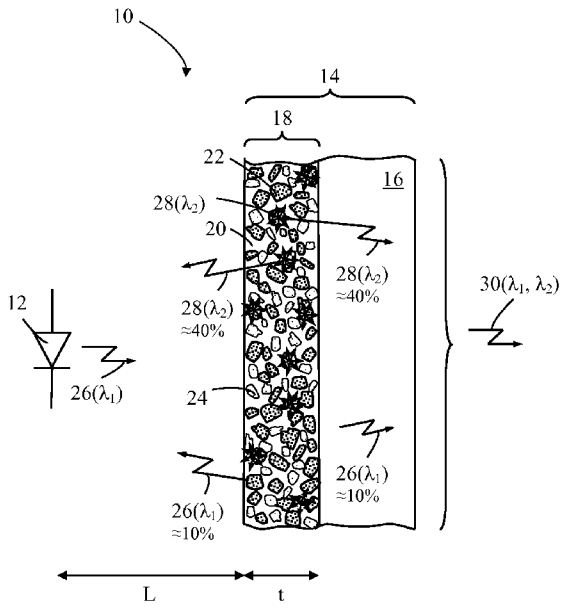

FIG. 1

(57) Abstract: A photoluminescent composition ("phosphor ink") comprises a suspension of particles of at least one blue light (380nm to 480nm) excitable phosphor material in a light transmissive liquid binder in which the weight loading of at least one phosphor material to binder material is in a range 40% to 75%. The binder can be U.V. curable, thermally curable, solvent based or a combination thereof and comprise a polymer resin; a monomer resin, an acrylic, a silicone or a fluorinated polymer. The composition can further comprise particles of a light reflective material suspended in the liquid binder. Photoluminescence wavelength conversion components; solid-state light emitting devices; light emitting signage surfaces and light emitting signage utilizing the composition are disclosed.

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LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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— *with international search report (Art. 21(3))*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 11/63057

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H01L 33/50; F21V 7/00 (2012.01)
USPC - 257/98; 257/E33.061; 362/341
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)
USPC -- 257/98; 257/E33.061; 362/341

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC -- 257/98; 257/E33.061; 362/341 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST (USPT, PGPB, JPAB, EPAB); Google
Search Terms Used: Phospor powder dispersion particle photoluminescent blue light light reflective light absorbing metal oxide magnesium resin slurry polymer acrylic binder substrate inkjet deposition

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/0116785 A1 (Ohno et al.) 22 May 2008 (22.05.2008), entire document especially Abstract, para [0003], [0004], [0109], [0115], [0040], [0091], [0110], [0075], [0079]	1, 3-7, 9-13, 37
X	US 2007/0138438 A1 (Hampden-Smith et al.) 21 June 2007 (21.06.2007), entire document especially Abstract, para [0242]-[0243], [0250], [0252] and [0158]	1, 2, 8
X	US 20010019240 A1 (Takahashi) 06 September 2001 (06.09.2001), para [0011]-[0017]	1
X	US 2007/0031097 A1 (Heikenfeld et al.) 08 February 2007 (08.02.2007), para [0008]-[0012]	1

☐ 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	Date of mailing of the international search report
26 July 2012 (26.07.2012)	23 AUG 2012
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 11/63057

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

The following claim groups were found:
Group I: Claims 1-13, 37
Group II: Claims 14-36, 38-42

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

---------- See Extra Sheet ----------

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-13, 37

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/US 11/63057

Box III: Observations where unity is lacking:

Group I: is drawn to a photoluminescent composition comprising: a suspension of particles of at least one phosphor material in a light transmissive liquid binder wherein the at least one phosphor material is excitable by blue light of wavelength 380nm to 480nm and wherein the weight loading of at least one phosphor material to binder material is in a range 40% to 75%.

Group II: is drawn to a photoluminescence wavelength conversion component for a solid-state light emitting device comprising: a substrate having on a surface thereof a layer of a photoluminescent composition that is excitable by blue light of wavelength 380nm to 480nm and wherein the composition is deposited on the substrate using a method selected from the group consisting of: screen printing; inkjet printing; letterpress printing, gravure printing; flexograph printing and pad printing and comprising a weight loading of at least one phosphor material to binder material is in a range 40% to 75%.

The inventions listed in the above-mentioned groups do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Groups I-II lack unity of invention, because even though the inventions of these groups require the technical features of a photoluminescent composition that is excitable by blue light of wavelength 380nm to 480nm and a weight loading of at least one phosphor material to binder material is in a range 40% to 75%, these technical features are not special technical features as they do not make a contribution over the prior art in view of US 2008/0116785 A1 to Ohno et al. (22 May 2008), which discloses a photoluminescent composition that is excitable (para [0003], [0004], [0115]) by blue light of wavelength 380nm to 480nm (para [0040], [0091], and a weight loading of at least one phosphor material to binder material is in a range 40% to 75% (para [0110]).

Further, Group I is directed to a photoluminescent composition known in the art and Group II is directed to an intended use as a photoluminescence wavelength conversion component.

Groups I and II therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.