



(12) **United States Patent**
Vasylyev

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(54) **LIGHT CONVERTING SYSTEM EMPLOYING PLANAR LIGHT TRAPPING AND LIGHT ABSORBING STRUCTURES**

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(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Division of application No. 15/442,645, filed on Feb. 25, 2017, now Pat. No. 10,269,999, which is a continuation of application No. 14/222,588, filed on Mar. 22, 2014, now abandoned, which is a continuation of application No. 13/181,482, filed on Jul. 12, 2011, now Pat. No. 8,735,791.

(Continued)

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H01L 27/00 (2006.01)
H01L 31/054 (2014.01)
G01J 1/04 (2006.01)
G01J 5/08 (2006.01)
G02B 5/02 (2006.01)
H01L 31/0232 (2014.01)
H01L 31/0525 (2014.01)
G02B 19/00 (2006.01)

(52) **U.S. Cl.**

CPC **H01L 31/0547** (2014.12); **G01J 1/0407** (2013.01); **G01J 5/0853** (2013.01); **G02B 5/0231** (2013.01); **G02B 5/0294** (2013.01); **G02B 19/0028** (2013.01); **H01L 31/02327** (2013.01); **H01L 31/0525** (2013.01); **H01L 31/0543** (2014.12); **Y02E 10/52** (2013.01)

(58) **Field of Classification Search**

CPC H01L 31/0525; H01L 31/02327; H01L 31/0543; H01L 31/0547
USPC 250/216, 203.1, 203.3, 203.4; 136/246, 136/256, 259; 385/33, 36
See application file for complete search history.

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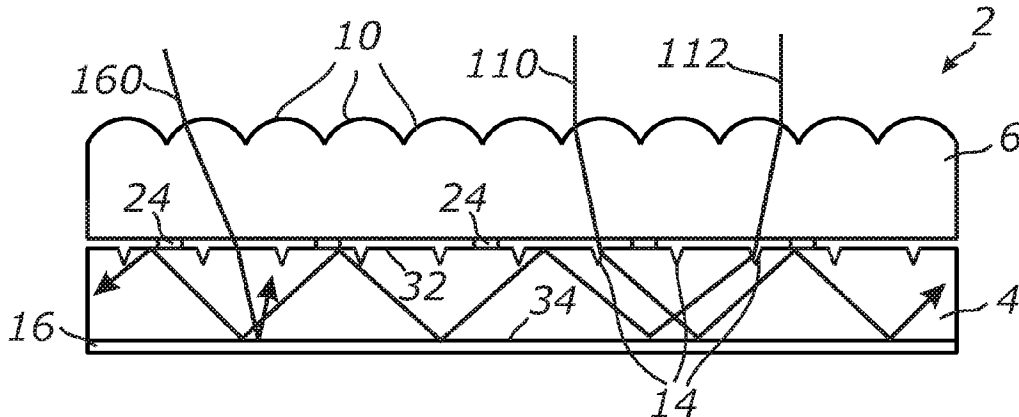
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Primary Examiner — Kevin K Pyo

(57) **ABSTRACT**

A light converting optical system employing a planar light trapping optical structure illuminated by a monochromatic light source. The light trapping optical structure includes a photoresponsive layer including semiconductor quantum dots. The photoresponsive layer is configured at a relatively low thickness and located between opposing broad-area surfaces that confine and redistribute light within the structure and cause multiple transverse propagation of unabsorbed light through the photoresponsive layer to enhance absorption. The light trapping optical structure further incorporates various microstructured surfaces including light-distributing surface relief features such as linear microlenses, prismatic surface relief features and/or linear grooves.

26 Claims, 7 Drawing Sheets



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Related U.S. Application Data

(60) Provisional application No. 61/402,061, filed on Aug. 21, 2010, provisional application No. 61/399,552, filed on Jul. 13, 2010.

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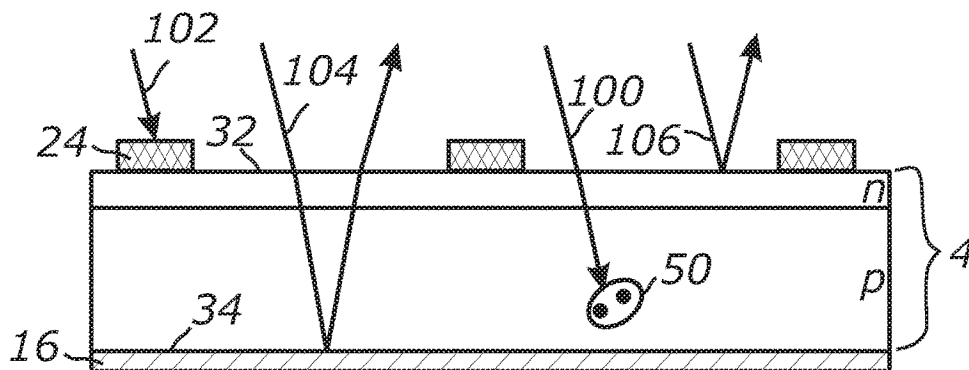


FIG. 1
(PRIOR ART)

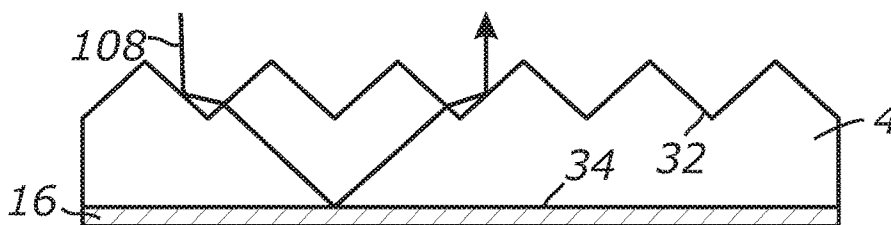


FIG. 2
(PRIOR ART)

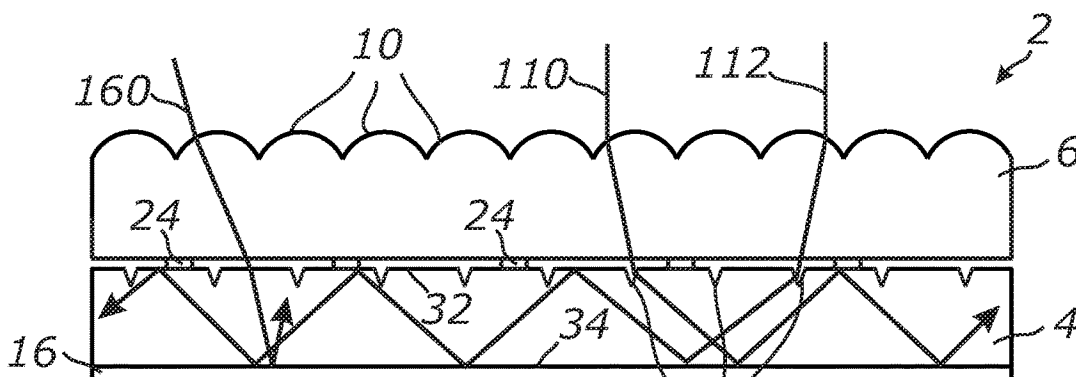


FIG. 3

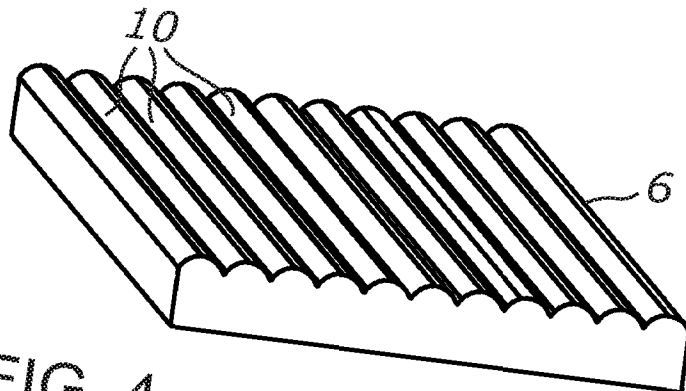


FIG. 4

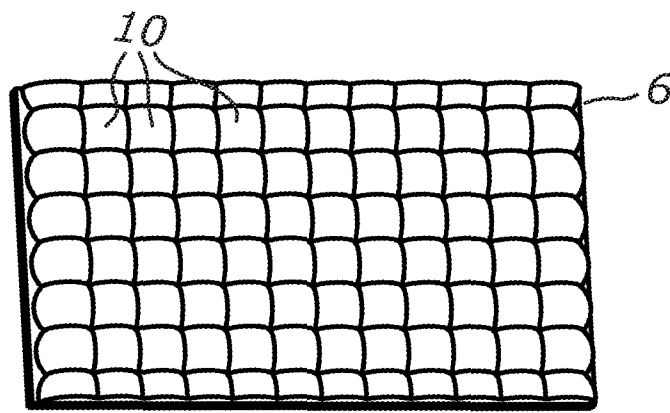


FIG. 5

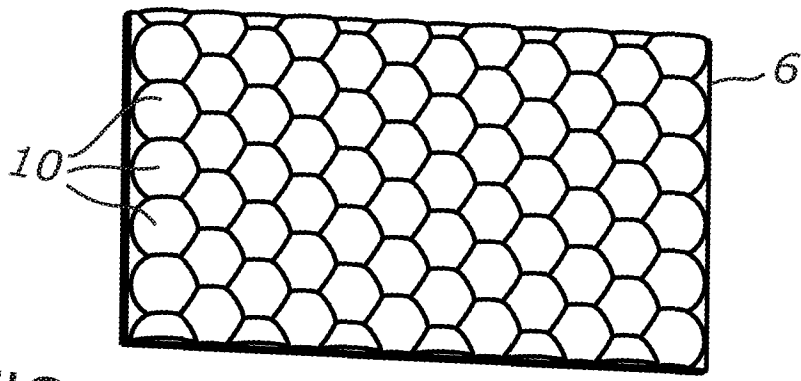


FIG. 6

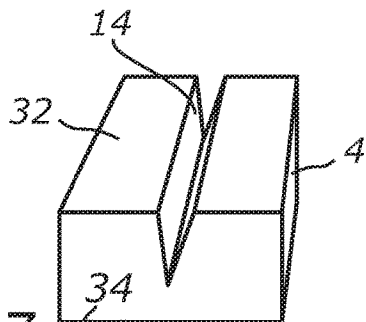


FIG. 7

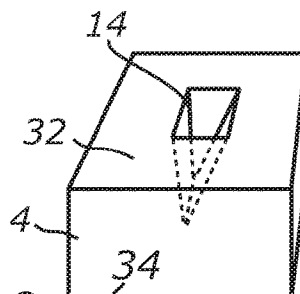


FIG. 8

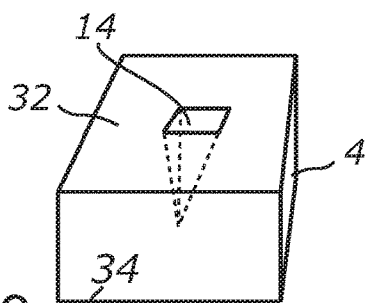


FIG. 9

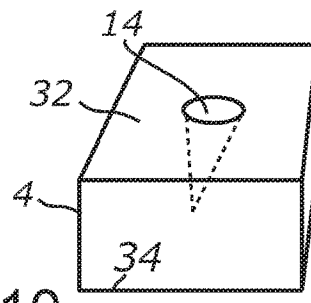


FIG. 10

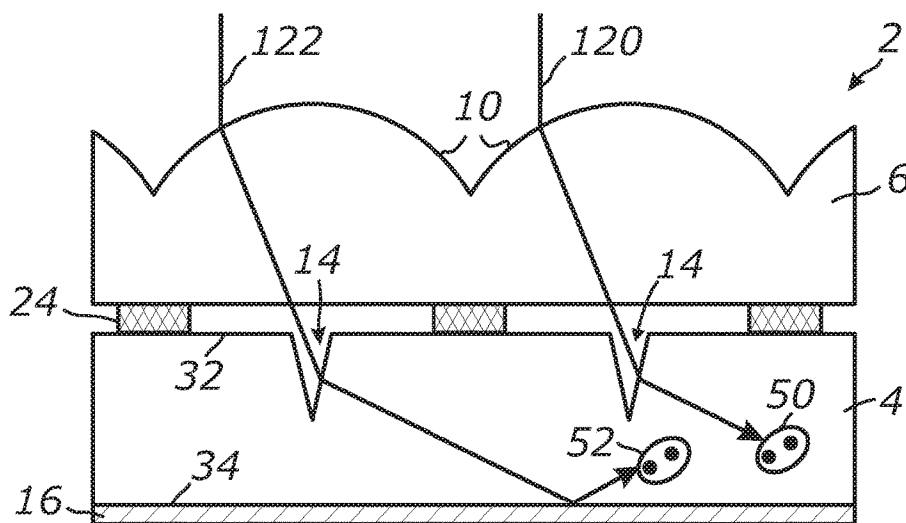


FIG. 11

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