



US009678321B2

(12) **United States Patent**  
**Vasylyev**

(10) **Patent No.:** **US 9,678,321 B2**  
(45) **Date of Patent:** **Jun. 13, 2017**

(54) **LIGHT TRAPPING OPTICAL STRUCTURE**

(71) Applicant: **Sergiy Vasylyev**, Elk Grove, CA (US)

(72) Inventor: **Sergiy Vasylyev**, Elk Grove, CA (US)

(73) Assignee: **SVV TECHNOLOGY INNOVATIONS, INC.**, Sacramento, CA (US)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/181,439**

(22) Filed: **Feb. 14, 2014**

(65) **Prior Publication Data**

US 2014/0158199 A1 Jun. 12, 2014

**Related U.S. Application Data**

(63) Continuation of application No. 13/572,629, filed on Aug. 11, 2012, now abandoned, which is a continuation of application No. 13/345,738, filed on Jan. 8, 2012, now Pat. No. 8,290,318, which is a continuation-in-part of application No. 12/764,867, filed on Apr. 21, 2010, now Pat. No. 9,256,007.

(Continued)

(51) **Int. Cl.**

**G02B 6/34** (2006.01)  
**G02B 6/32** (2006.01)  
**H01L 31/00** (2006.01)  
**G02B 19/00** (2006.01)  
**H01L 31/054** (2014.01)  
**H02S 40/22** (2014.01)  
**G02B 3/00** (2006.01)  
**H02S 40/00** (2014.01)

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

CPC ..... **G02B 19/0028** (2013.01); **H01L 31/054** (2014.12); **H01L 31/0543** (2014.12); **H01L 31/0547** (2014.12); **H02S 40/22** (2014.12); **G02B 3/005** (2013.01); **G02B 3/0056** (2013.01); **G02B 19/0004** (2013.01); **H02S 40/00** (2013.01); **Y02E 10/52** (2013.01)

(58) **Field of Classification Search**

CPC ... **G02B 19/0028**; **H02S 40/22**; **H01L 31/054**; **H01L 31/0543**; **H01L 31/0547**; **Y02E 10/52**  
USPC ..... **385/33, 36; 136/246, 259; 257/E25.009**  
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

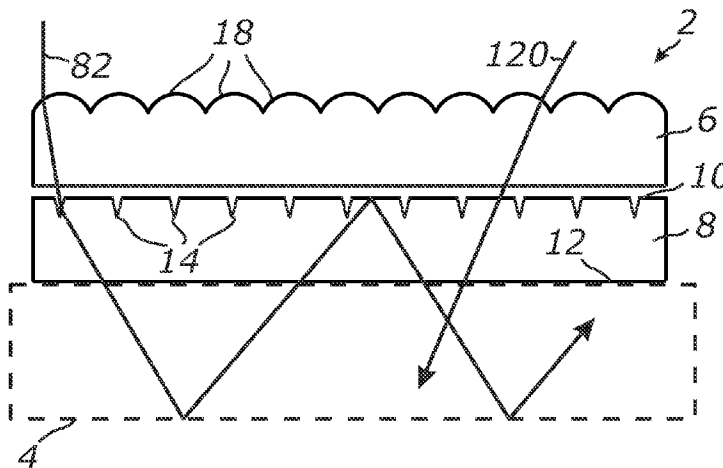
6,008,449 A \* 12/1999 Cole ..... 136/246  
6,274,860 B1 8/2001 Rosenberg  
(Continued)

Primary Examiner — Robert Tavlykaev

(57) **ABSTRACT**

A light trapping optical cover employing an optically transparent layer with a plurality of light deflecting elements. The transparent layer is configured for an unimpeded light passage through its body and has a broad light input surface and an opposing broad light output surface. The light deflecting elements deflect light incident into the transparent layer at a sufficiently high bend angle with respect to a surface normal and direct the deflected light toward a light harvesting device adjacent to the light output surface. The deflected light is retained by means of at least TIR in the system formed by the optical cover and the light harvesting device which allows for longer light propagation paths through the photoabsorptive layer of the device and for an improved light absorption. The optical cover may further employ a focusing array of light collectors being pairwise associated with the respective light deflecting elements.

**19 Claims, 11 Drawing Sheets**



**US 9,678,321 B2**

Page 2

**Related U.S. Application Data**

- (60) Provisional application No. 61/214,331, filed on Apr. 21, 2009, provisional application No. 61/461,522, filed on Jan. 18, 2011.

**(56) References Cited**

## U.S. PATENT DOCUMENTS

6,333,458	B1	12/2001	Forrest et al.	
6,440,769	B2	8/2002	Peumans et al.	
7,672,549	B2	3/2010	Ghosh et al.	
7,817,885	B1	10/2010	Moore et al.	
8,338,693	B2 *	12/2012	Raymond	..... H01L 31/0547 136/246
8,354,583	B2 *	1/2013	Zaban et al.	..... 136/246
8,402,647	B2 *	3/2013	Chui	..... G02B 6/0036 29/428
2004/0103938	A1	6/2004	Rider	
2008/0264483	A1	10/2008	Keshner et al.	
2009/0126792	A1	5/2009	Gruhlke et al.	
2009/0199900	A1 *	8/2009	Bitá et al.	..... 136/259
2010/0180929	A1 *	7/2010	Raymond et al.	..... 136/246
2010/0186798	A1	7/2010	Tormen et al.	
2010/0278480	A1	11/2010	Vasylyev	
2011/0226332	A1	9/2011	Ford et al.	
2012/0012741	A1	1/2012	Vasylyev	

\* cited by examiner

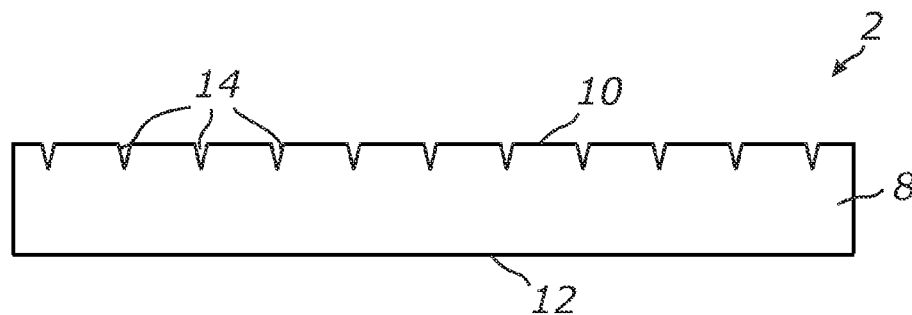


FIG. 1

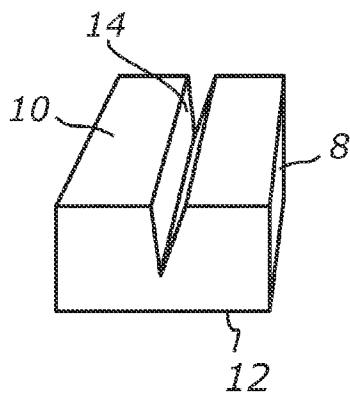


FIG. 2

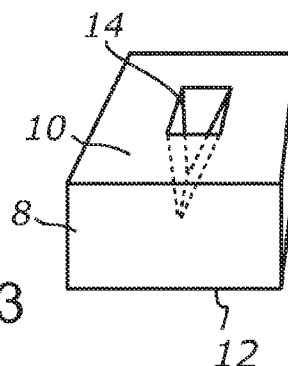


FIG. 3

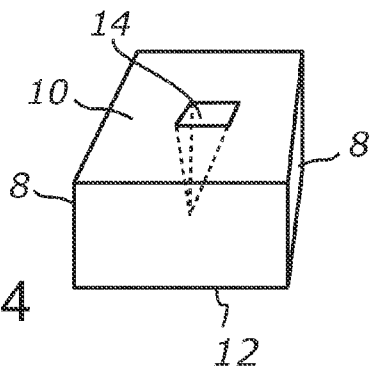


FIG. 4

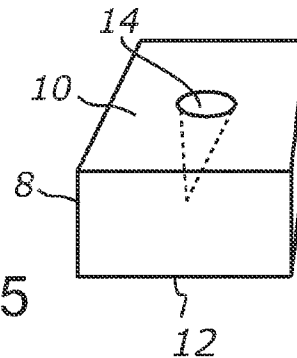
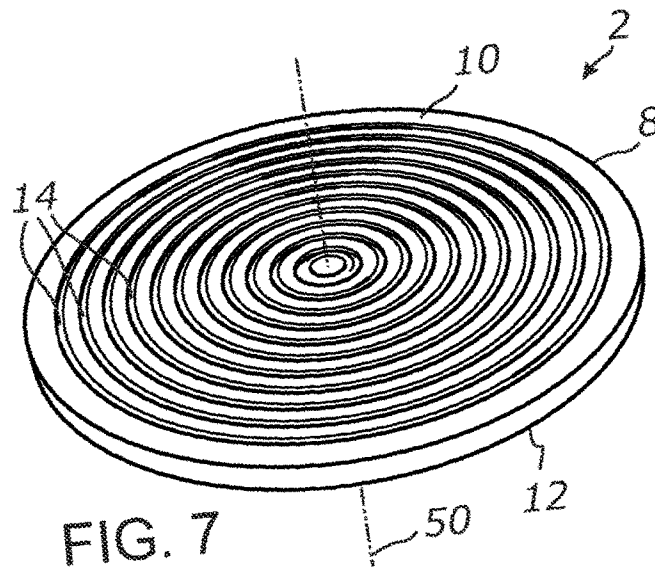
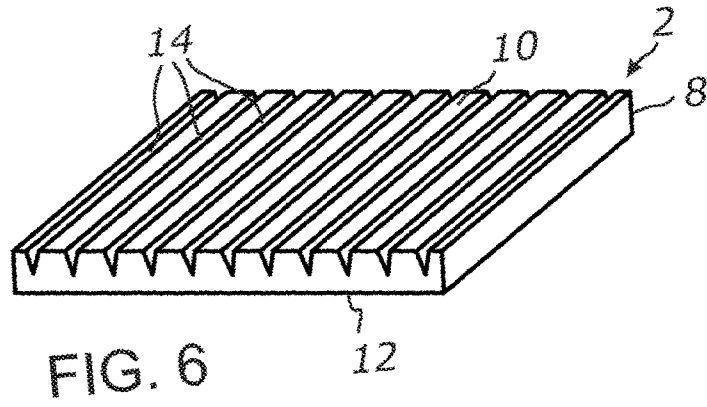


FIG. 5



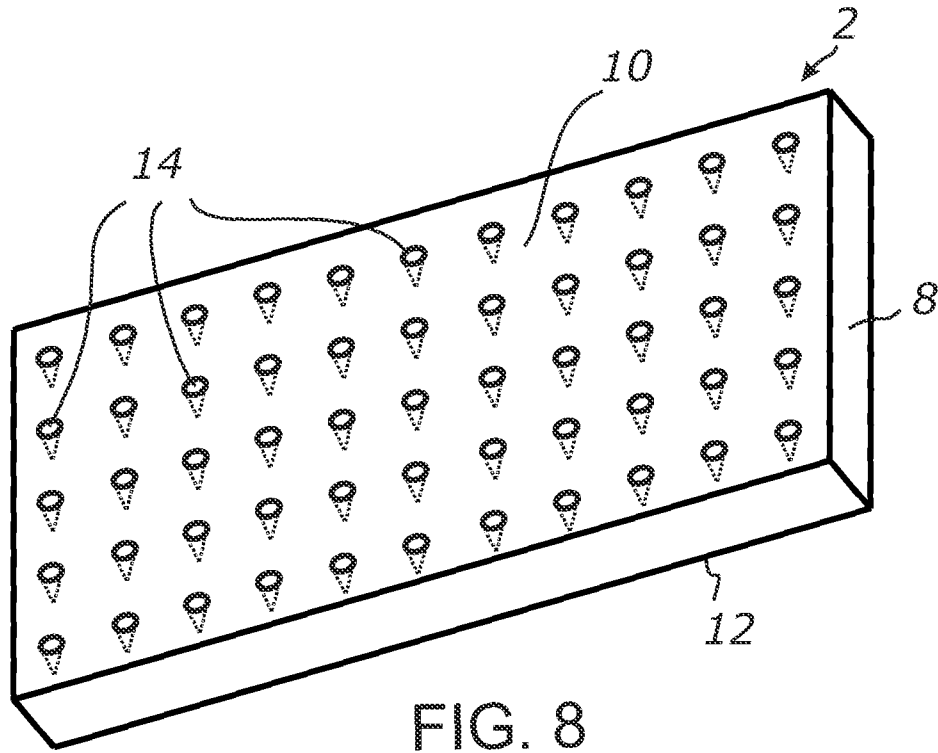


FIG. 8

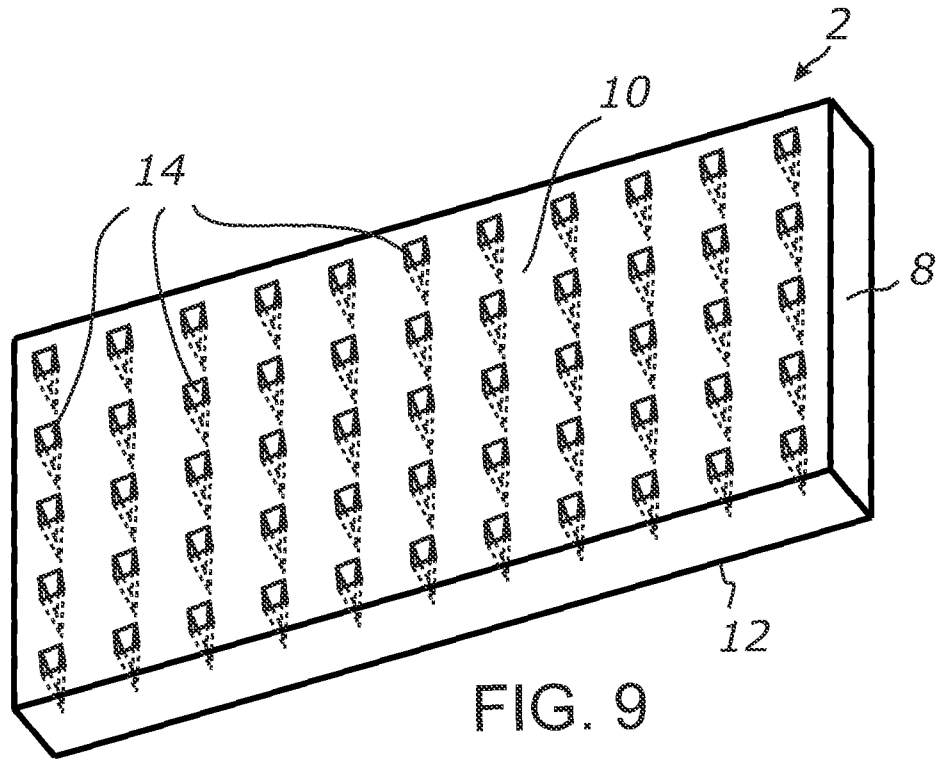


FIG. 9

# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

## LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

## FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

## E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.