# The United States of America

## The Director of the United States Patent and Trademark Office

*Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.*

*Therefore, this*

## United States Patent

*Grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America, and if the invention is a process, of the right to exclude others from using, offering for sale or selling throughout the United States of America, or importing into the United States of America, products made by that process, for the term set forth in 35 U.S.C. 154(a)(2) or (c)(1), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b). See the Maintenance Fee Notice on the inside of the cover.*

Michelle K. Lee

*Director of the United States Patent and Trademark Office*

US008876334B2

# (12) United States Patent
**Chung et al.**

(10) **Patent No.: US 8,876,334 B2**

(45) **Date of Patent: *Nov. 4, 2014**

(54) **LIGHT-MIXING MULTICHIP PACKAGE STRUCTURE**

(75) Inventors: **Chia-Tin Chung**, Miaoli County (TW); **Shih-Neng Tai**, Taoyuan County (TW)

(73) Assignee: **Paragon Semiconductor Lighting Technology Co., Ltd.**, New Taipei (TW)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 369 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/350,968**

(22) Filed: **Jan. 16, 2012**

(65) **Prior Publication Data**

US 2013/0181601 A1 Jul. 18, 2013

(51) **Int. Cl.**

***F21V 29/00*** (2006.01)
***H01L 23/34*** (2006.01)

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

USPC . **362/294**; 362/235; 362/311.02; 362/311.04; 257/98; 257/100; 257/712

(58) **Field of Classification Search**

CPC ........... H01L 2224/48091; H01L 2224/73265; H01L 2224/48227; H01L 2224/48247; H01L 2924/00; H01L 2924/00014; H01L 2924/12041; H01L 27/12; H01L 25/0753; H01L 33/62; H01L 33/08; H01L 33/60; H01L 33/486; H01L 33/502; H01L 33/405; H01L 25/167

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

| | | | | |
|---|---|---|---|---|
| 2009/0046456 | A1* | 2/2009 | Urano et al. | 362/235 |
| 2010/0045790 | A1* | 2/2010 | Lynam et al. | 348/140 |
| 2011/0096560 | A1* | 4/2011 | Ryu et al. | 362/510 |
| 2011/0260646 | A1* | 10/2011 | Moon et al. | 315/294 |
| 2012/0014110 | A1* | 1/2012 | Sanpei et al. | 362/296.04 |
| 2012/0080674 | A1* | 4/2012 | Shimizu et al. | 257/48 |
| 2012/0187865 | A1* | 7/2012 | Chung et al. | 315/294 |
| 2012/0268929 | A1* | 10/2012 | Chung et al. | 362/231 |
| 2013/0193462 | A1* | 8/2013 | Ishizaki et al. | 257/88 |

* cited by examiner

*Primary Examiner* — Ashok Patel

(74) *Attorney, Agent, or Firm* — Li & Cai Intellectual Property (USA) Office

(57) **ABSTRACT**

A light-mixing multichip package structure includes a substrate unit, a light-emitting unit, a package unit, and a frame unit. The substrate unit includes a substrate body. The light-emitting unit includes a plurality of first and second light-emitting groups. The first and the second light-emitting groups are disposed on the substrate body and electrically connected to the substrate body in series. Each first light-emitting group includes a plurality of first parallel connection units electrically connected in parallel, and each first parallel connection unit includes at least one blue LED chip, and each second light-emitting group includes at least one red LED chip. The package unit includes a phosphor resin body disposed on the substrate body to cover the first and the second light-emitting groups. The frame unit includes a surrounding light-reflecting frame surrounding the first and the second light-emitting groups and the phosphor resin body.

**21 Claims, 13 Drawing Sheets**