



US006821804B2

(12) **United States Patent**
Thibeault et al.

(10) **Patent No.:** **US 6,821,804 B2**
(45) **Date of Patent:** **Nov. 23, 2004**

(54) **ENHANCED LIGHT EXTRACTION IN LEDS THROUGH THE USE OF INTERNAL AND EXTERNAL OPTICAL ELEMENTS**

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(75) Inventors: **Brian Thibeault**, Santa Barbara, CA (US); **Michael Mack**, Goleta, CA (US); **Steven DenBaars**, Goleta, CA (US)

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(73) Assignee: **Cree, Inc.**, Goleta, CA (US)

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

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(21) Appl. No.: **10/665,595**

A. Kock and E. Gornick, *Strongly Directional Emission From AlGaAs/GaAs Light-Emitting Diodes*, Applied Physics Letters 57, pp. 2327-2329 (1990).

(22) Filed: **Sep. 17, 2003**

(65) **Prior Publication Data**

(List continued on next page.)

US 2004/0041164 A1 Mar. 4, 2004

Related U.S. Application Data

Primary Examiner—Minhloan Tran

Assistant Examiner—Remmon R. Fordé

(74) *Attorney, Agent, or Firm*—Koppel, Jacobs, Patrick & Heybl

(62) Division of application No. 09/727,803, filed on Nov. 28, 2000, now Pat. No. 6,657,236.

(60) Provisional application No. 60/168,817, filed on Dec. 3, 1999.

(51) **Int. Cl.**⁷ **H01L 33/00**

(52) **U.S. Cl.** **438/29**; 438/22; 438/23; 438/24; 438/32; 438/42; 438/44; 257/98; 257/99; 257/94; 257/95

(58) **Field of Search** 438/29, 23, 22, 438/24, 32, 42, 44; 257/98, 99, 94, 95

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ABSTRACT

This invention describes new LEDs having light extraction structures on or within the LED to increase its efficiency. The new light extraction structures provide surfaces for reflecting, refracting or scattering light into directions that are more favorable for the light to escape into the package. The structures can be arrays of light extraction elements or disperser layers. The light extraction elements can have many different shapes and are placed in many locations to increase the efficiency of the LED over conventional LEDs. The disperser layers provide scattering centers for light and can be placed in many locations as well. The new LEDs with arrays of light extraction elements are fabricated with standard processing techniques making them highly manufacturable at costs similar to standard LEDs. The new LEDs with disperser layers are manufactured using new methods and are also highly manufacturable.

4 Claims, 6 Drawing Sheets

