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(12) **United States Patent**
Negley

(10) **Patent No.:** **US 7,714,345 B2**
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(54) **LIGHT-EMITTING DEVICES HAVING
COPLANAR ELECTRICAL CONTACTS
ADJACENT TO A SUBSTRATE SURFACE
OPPOSITE AN ACTIVE REGION AND
METHODS OF FORMING THE SAME**

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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 235 days.

(Continued)

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International Search Report and Written Opinion for PCT US2004/011357, Dec. 9, 2004.

(65) **Prior Publication Data**

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Primary Examiner—Allan R. Wilson

Related U.S. Application Data

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(57) **ABSTRACT**

(51) **Int. Cl.**

H01L 27/15 (2006.01)

A light-emitting device includes a substrate having first and second opposing surfaces. An active region is on the first surface and first and second electrical contacts are adjacent to the second surface and are conductively coupled to the active region. In other embodiments, a light-emitting device includes a substrate having first and second opposing surfaces. An active region is on the first surface and includes a first active layer having a first conductivity type on the first surface and a second active layer having a second conductivity type on the first active layer. A first electrical contact is adjacent to the second surface. A contact plug extends through the substrate and the active region and couples the first electrical contact to the second active layer. A second electrical contact is coupled to the substrate at the second surface.

(52) **U.S. Cl.** **257/99; 257/E33.062; 257/E33.066**

(58) **Field of Classification Search** 257/99, 257/E33.062, E33.066

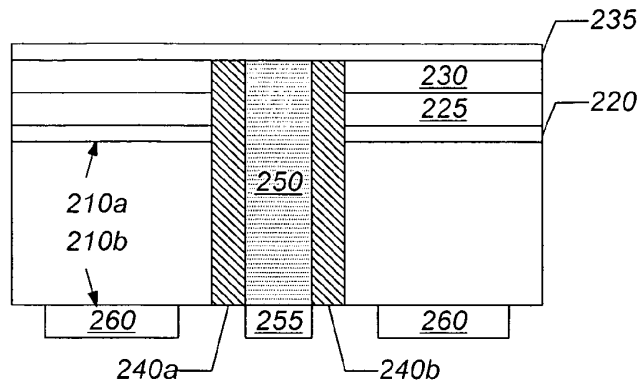
See application file for complete search history.

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37 Claims, 5 Drawing Sheets



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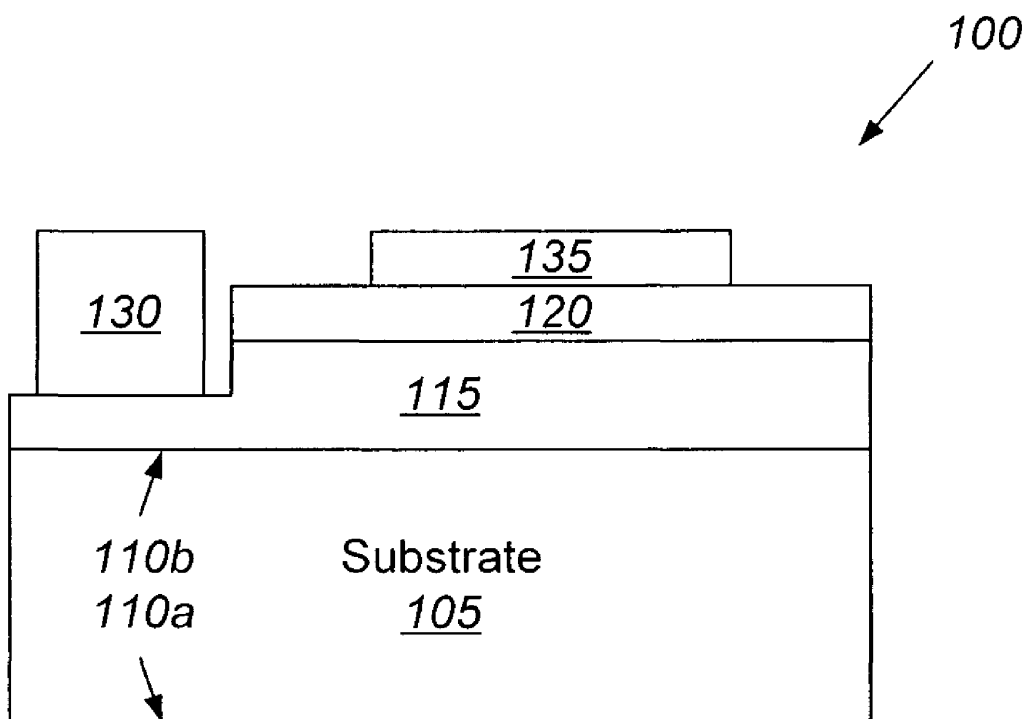


FIG. 1
(PRIOR ART)

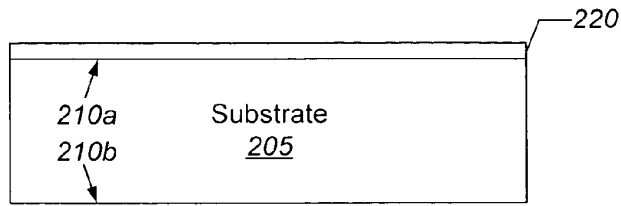


FIG. 2A

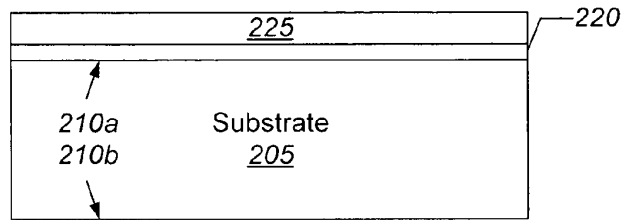


FIG. 2B

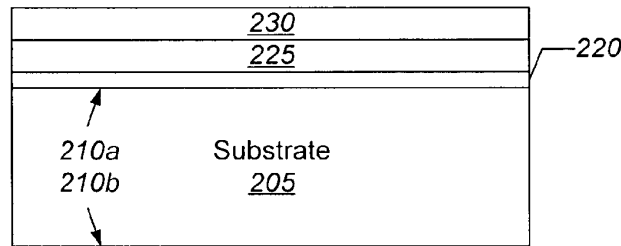


FIG. 2C

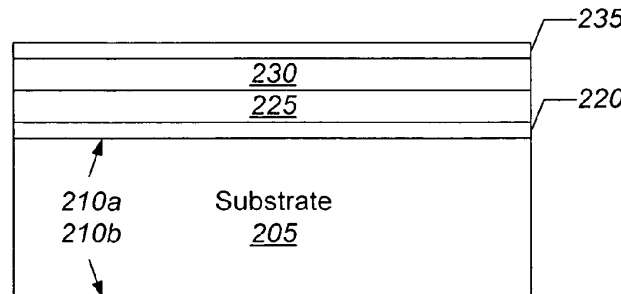


FIG. 2D

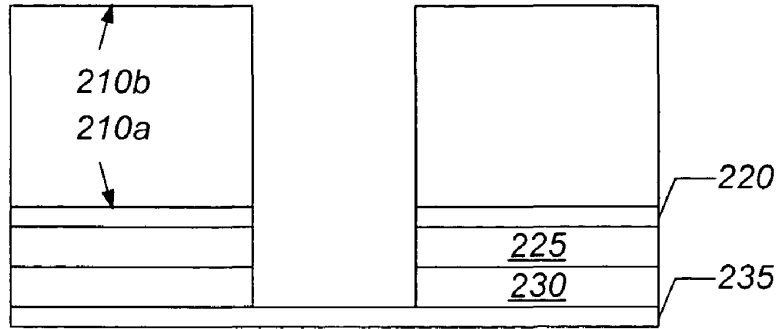


FIG. 2E

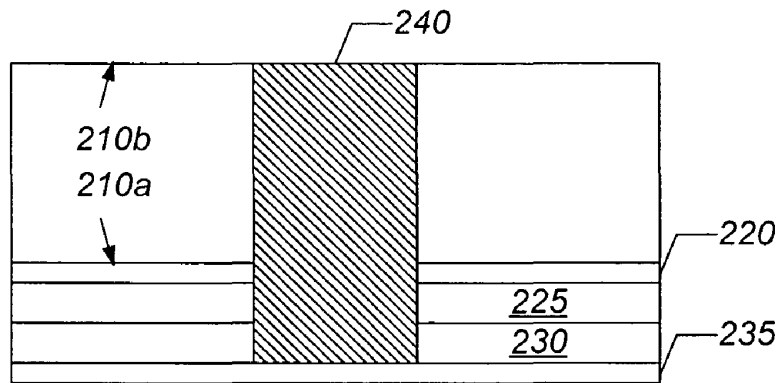


FIG. 2F

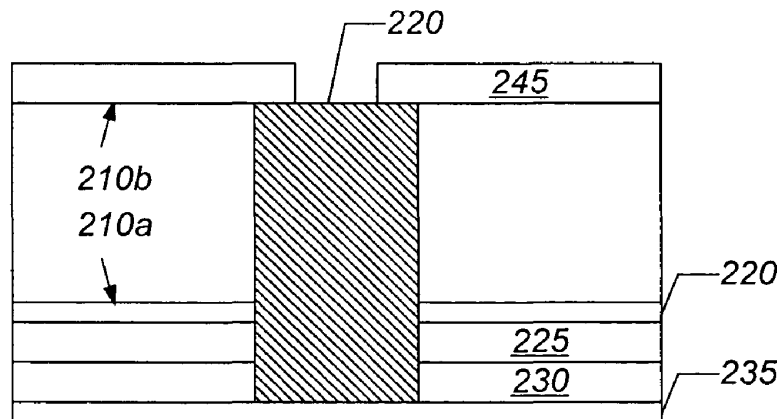


FIG. 2G

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