



# United States Patent [19]

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Edmond et al.

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- [54] **VERTICAL GEOMETRY LIGHT EMITTING DIODE WITH GROUP III NITRIDE ACTIVE LAYER AND EXTENDED LIFETIME**
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- [73] Assignee: **Cree Research, Inc.**, Durham, N.C.
- [21] Appl. No.: **309,251**
- [22] Filed: **Sep. 20, 1994**
- [51] Int. Cl.<sup>6</sup> ..... **H01L 31/0312; H01L 33/00**
- [52] U.S. Cl. .... **257/77; 257/96; 257/97; 257/103**
- [58] Field of Search ..... **257/77, 96, 97, 257/103; 372/43, 44, 45, 46**

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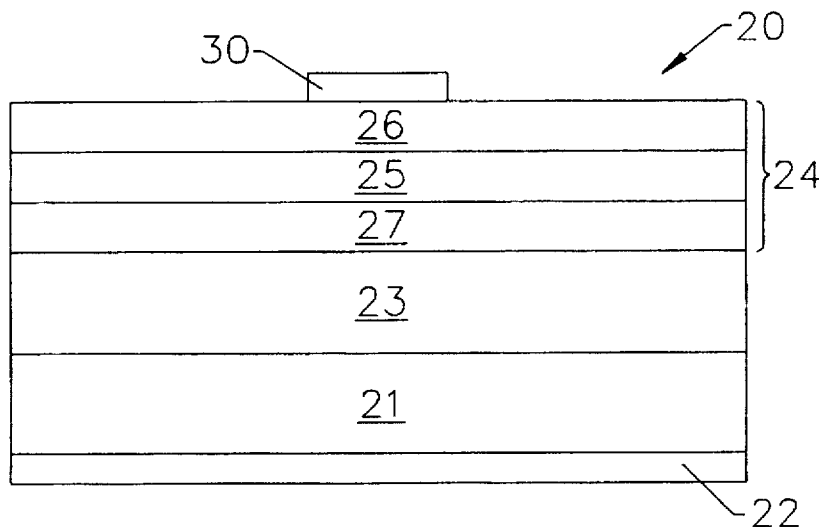
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[57] **ABSTRACT**

A light emitting diode emits in the blue portion of the visible spectrum and is characterized by an extended lifetime. The light emitting diode comprises a conductive silicon carbide substrate; an ohmic contact to the silicon carbide substrate; a conductive buffer layer on the substrate and selected from the group consisting of gallium nitride, aluminum nitride, indium nitride, ternary Group III nitrides having the formula A<sub>x</sub>B<sub>1-x</sub>N, where A and B are Group III elements and where x is zero, one, or a fraction between zero and one, and alloys of silicon carbide with such ternary Group III nitrides; and a double heterostructure including a p-n junction on the buffer layer in which the active and heterostructure layers are selected from the group consisting of binary Group III nitrides and ternary Group III nitrides.

**36 Claims, 4 Drawing Sheets**



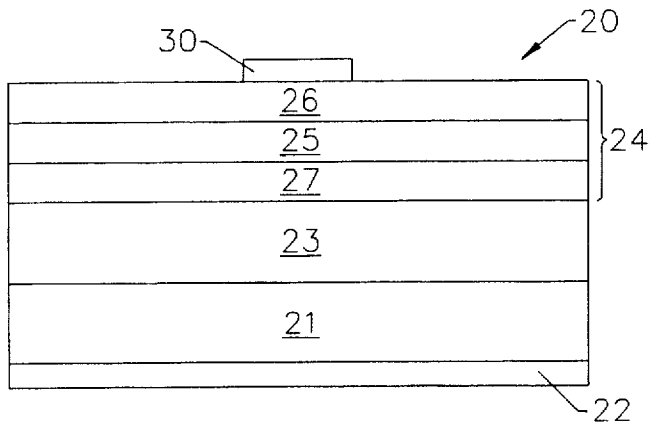


FIG. 1.

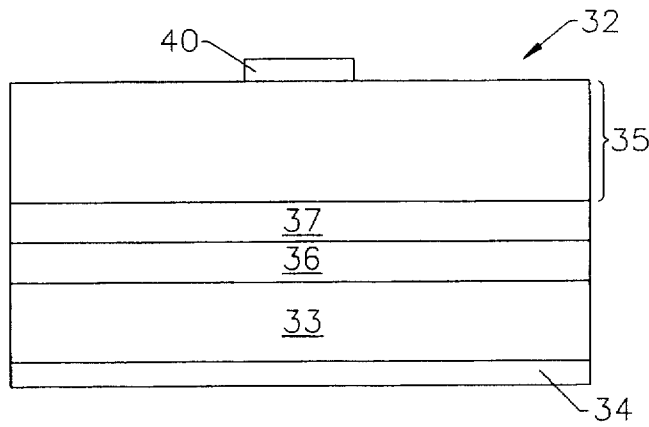


FIG. 2.

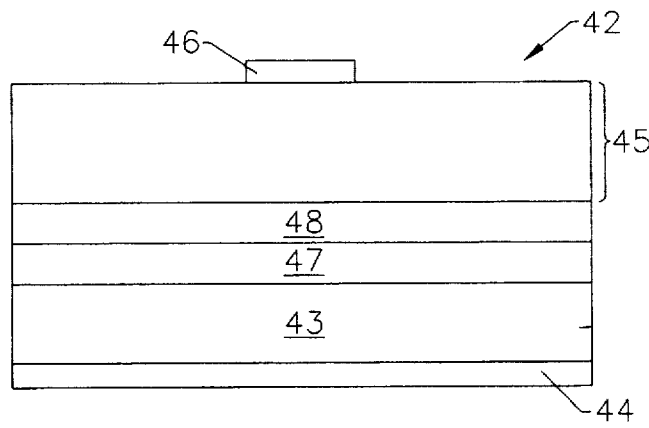


FIG. 3.

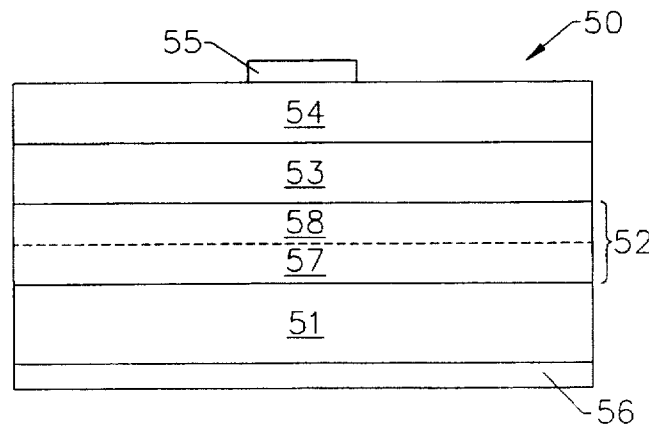


FIG. 4.

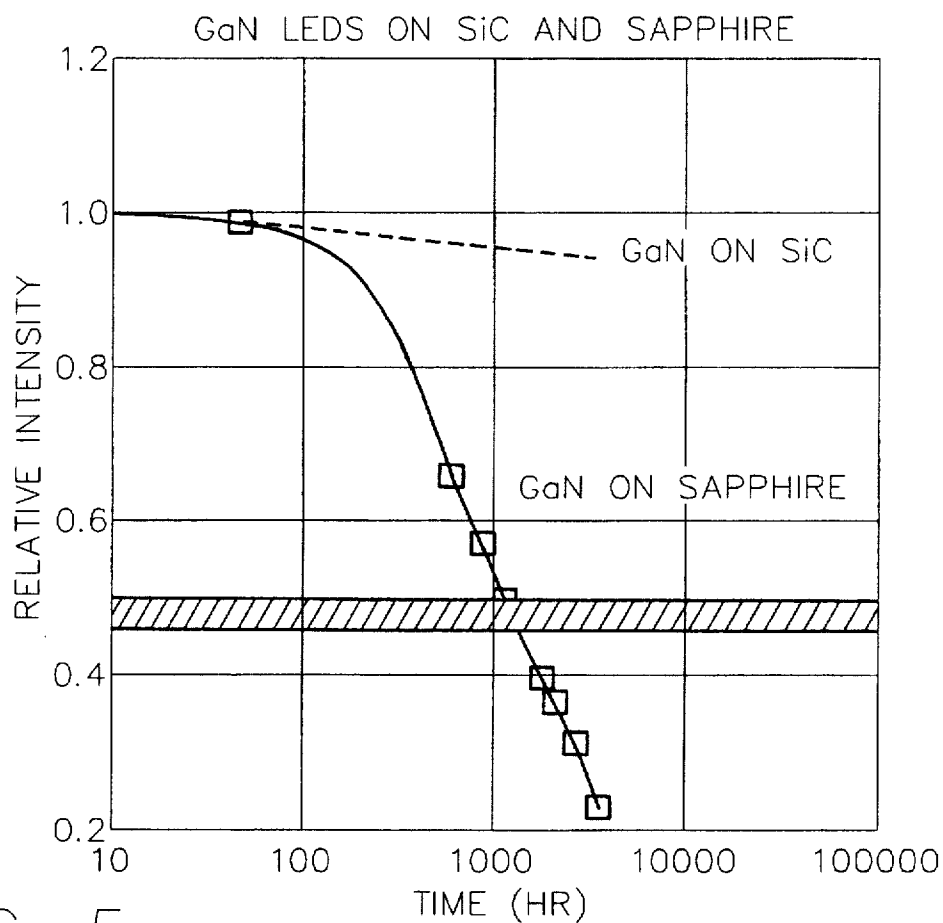


FIG. 5.

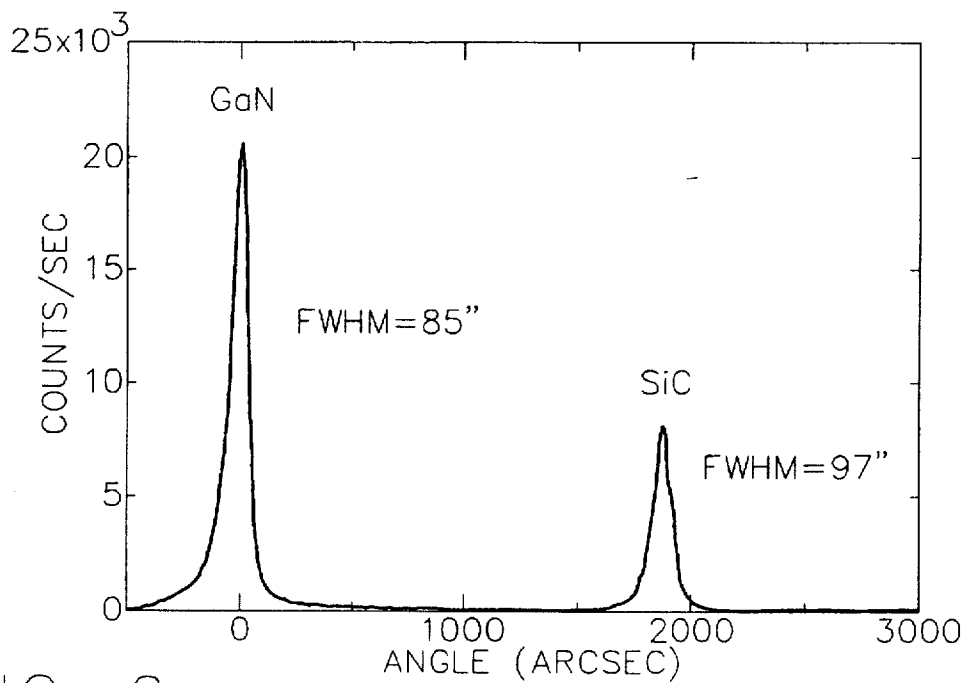


FIG. 6.

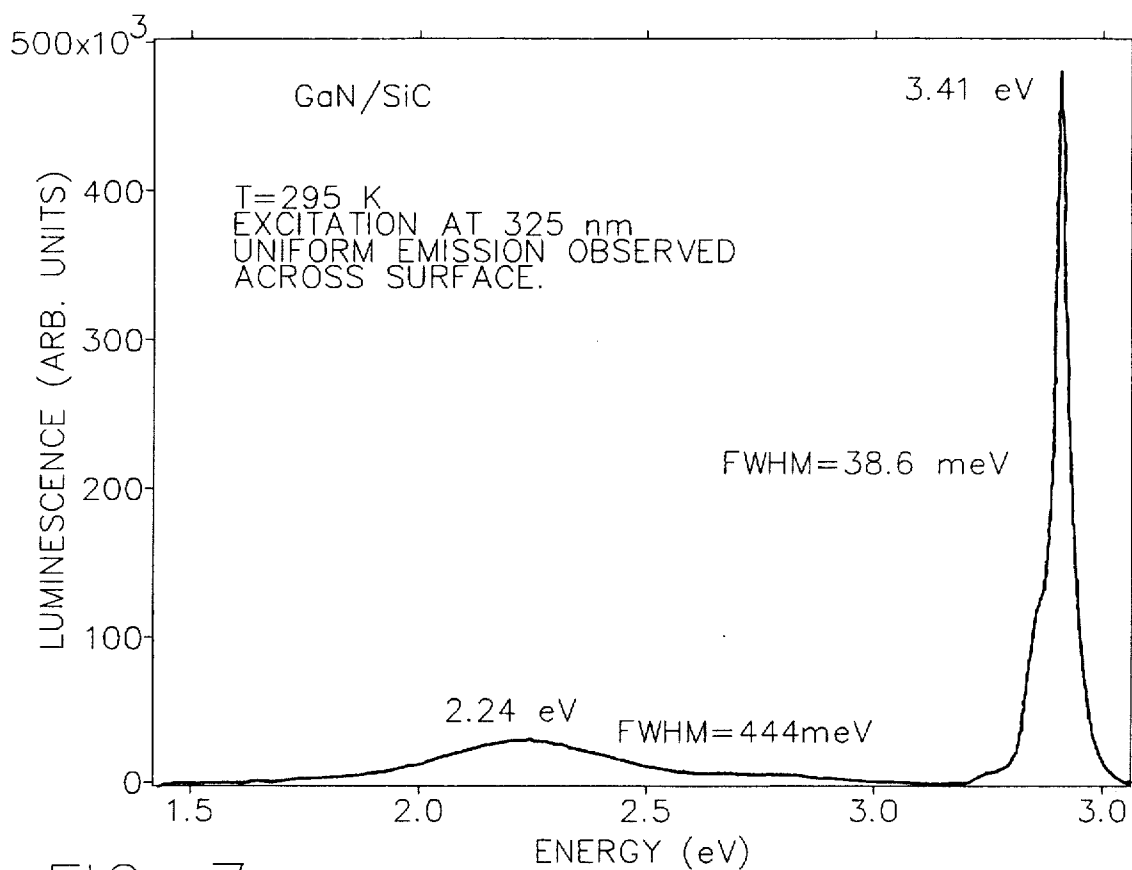


FIG. 7.

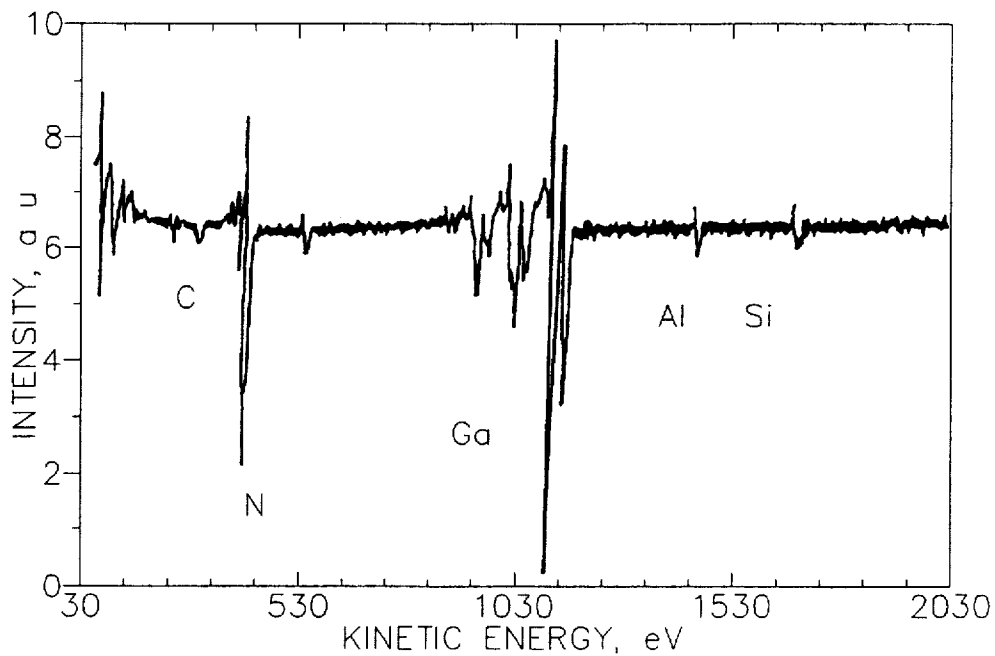


FIG. 8.

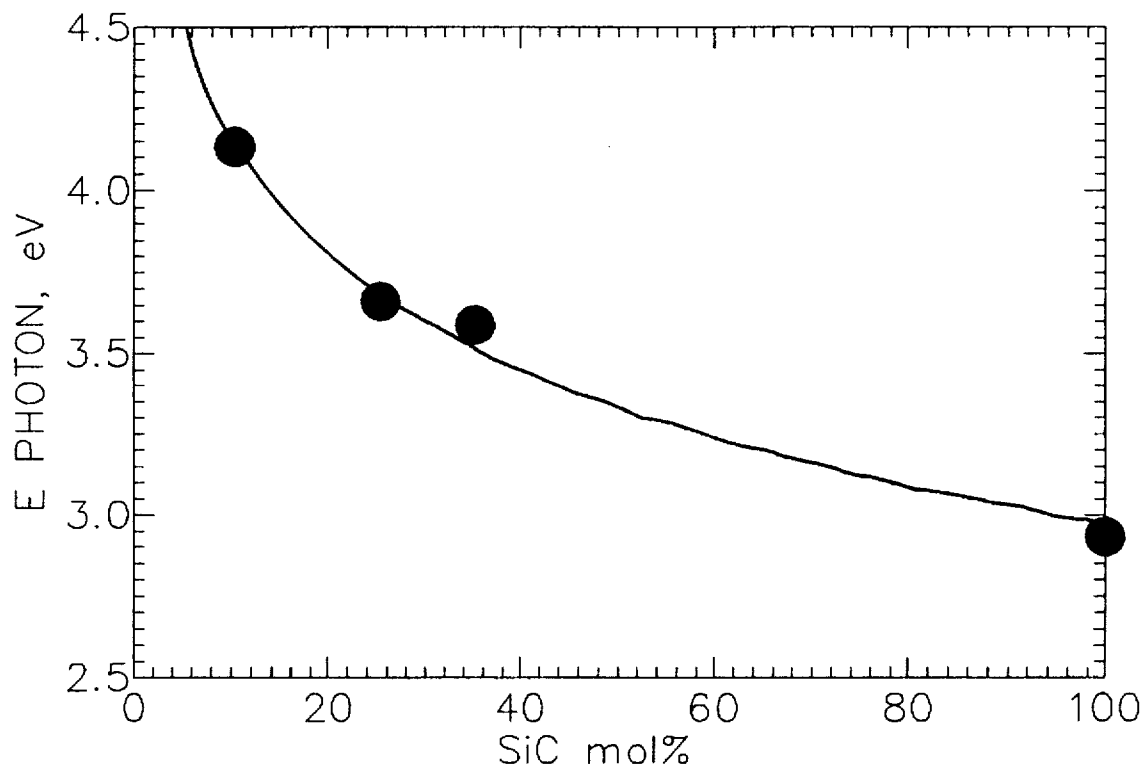


FIG. 9.

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