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**United States Patent** [19]  
**Shimizu et al.**

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[45] **Date of Patent:** **Dec. 7, 1999**

- [54] **LIGHT EMITTING DEVICE HAVING A NITRIDE COMPOUND SEMICONDUCTOR AND A PHOSPHOR CONTAINING A GARNET FLUORESCENT MATERIAL**
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- [73] Assignee: **Nichia Kagaku Kogyo Kabushiki Kaisha**, Tokushima, Japan

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[30] **Foreign Application Priority Data**

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Sep. 17, 1996	[JP]	Japan	8-244339
Sep. 18, 1996	[JP]	Japan	8-245381
Dec. 27, 1996	[JP]	Japan	8-359004
Mar. 31, 1997	[JP]	Japan	9-081010

- [51] **Int. Cl.<sup>6</sup>** ..... **H01J 1/62; H01J 63/04**
- [52] **U.S. Cl.** ..... **313/503; 313/498; 313/501; 313/502; 257/103**
- [58] **Field of Search** ..... **313/498, 503, 313/501, 502; 257/103**

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[57] **ABSTRACT**

The white light emitting diode comprising a light emitting component using a semiconductor as a light emitting layer and a phosphor which absorbs a part of light emitted by the light emitting component and emits light of wavelength different from that of the absorbed light, wherein the light emitting layer of the light emitting component is a nitride compound semiconductor and the phosphor contains garnet fluorescent material activated with cerium which contains at least one element selected from the group consisting of Y, Lu, Sc, La, Gd and Sm, and at least one element selected from the group consisting of Al, Ga and In and, and is subject to less deterioration of emission characteristic even when used with high luminance for a long period of time.

**23 Claims, 19 Drawing Sheets**

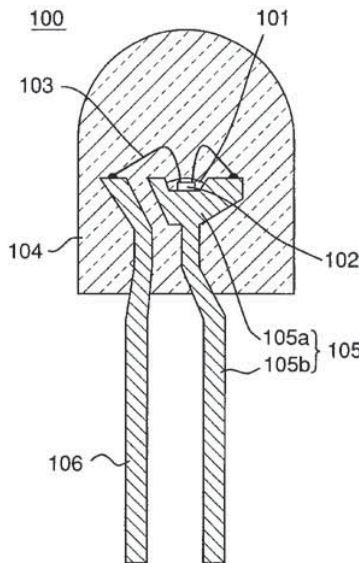


Fig. 1

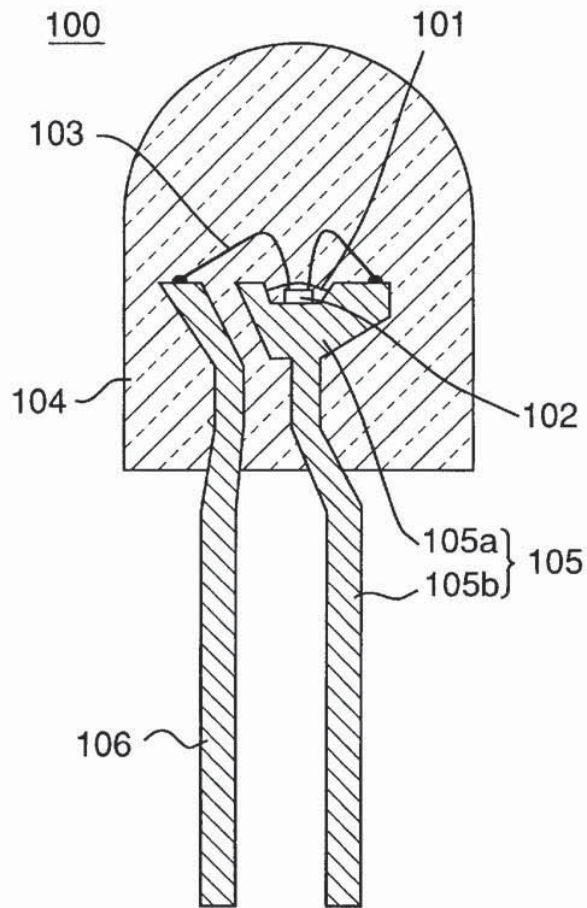
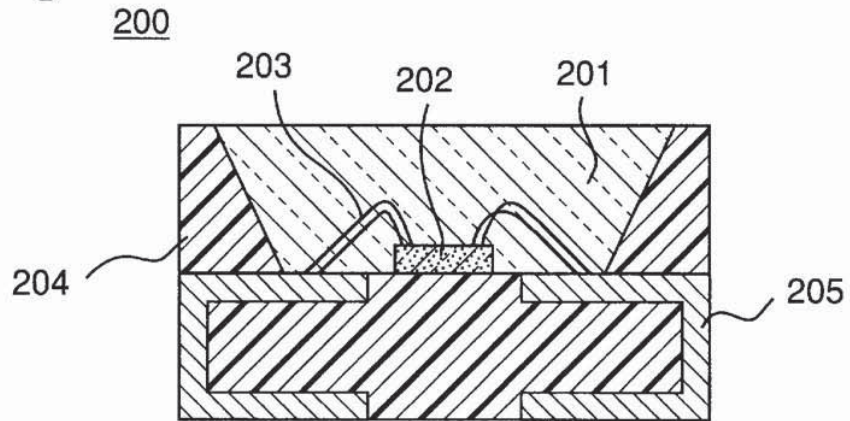
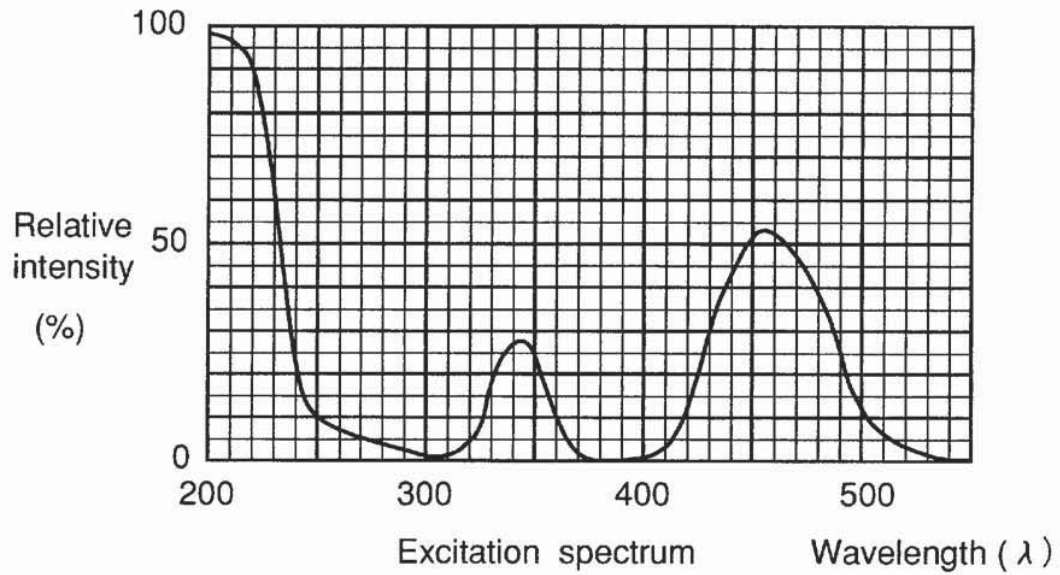


Fig. 2



*Fig.3A*



*Fig.3B*

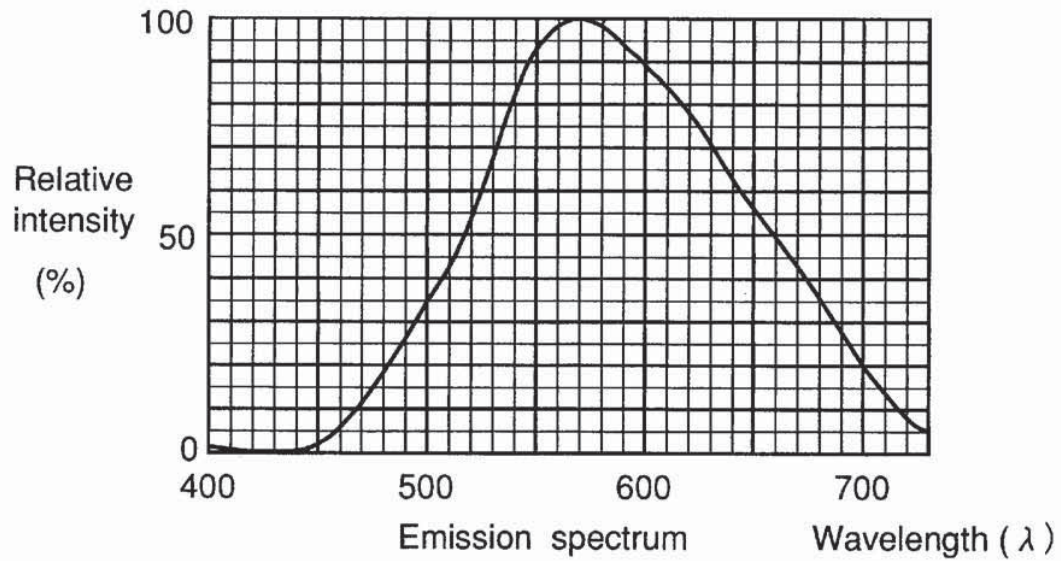


Fig. 4

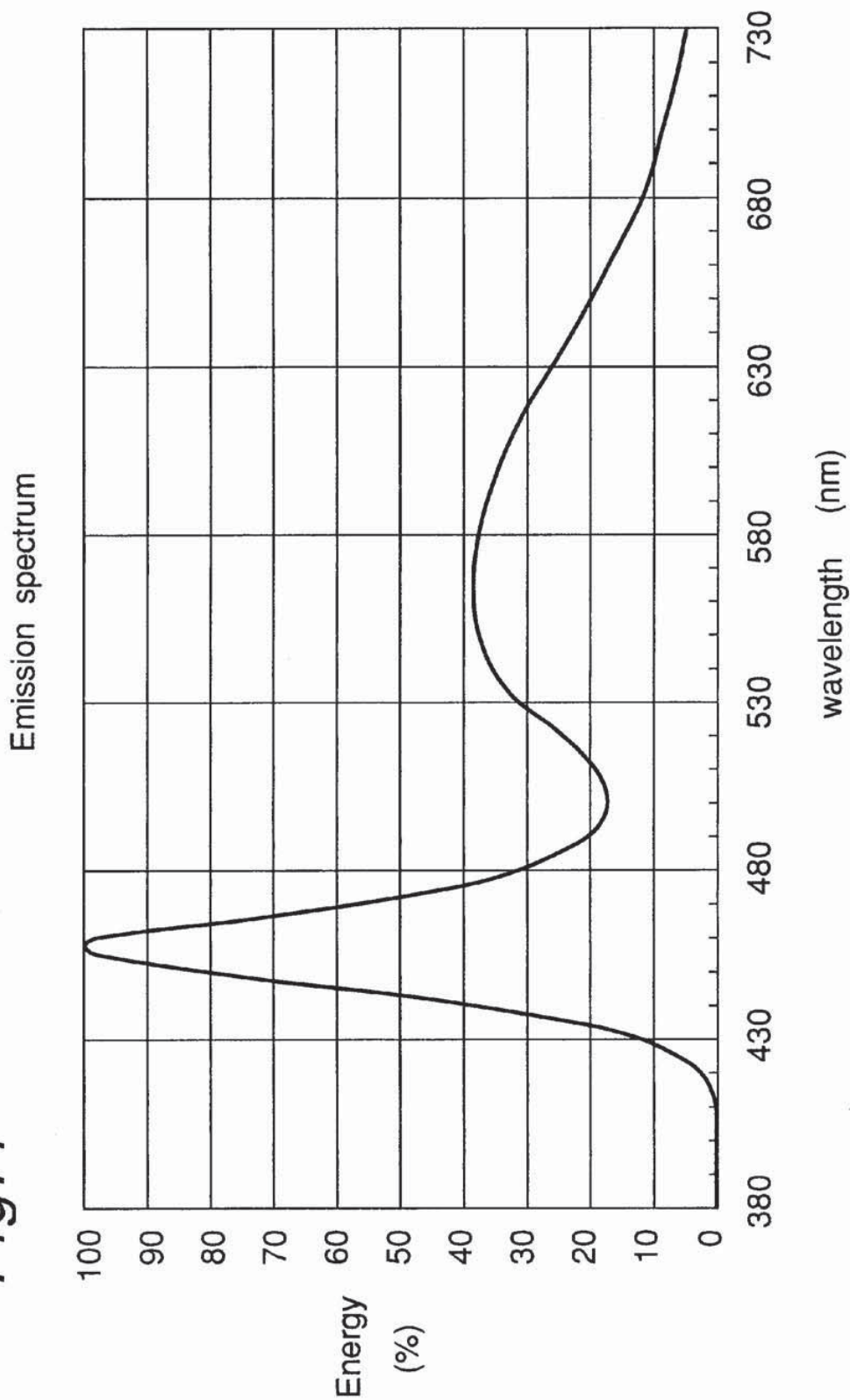


Fig.5A

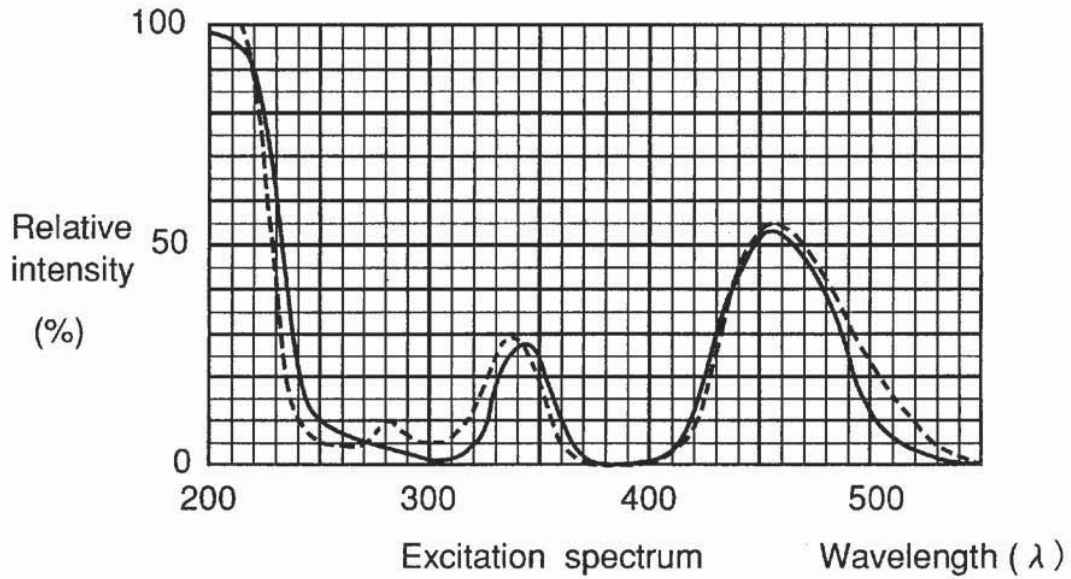
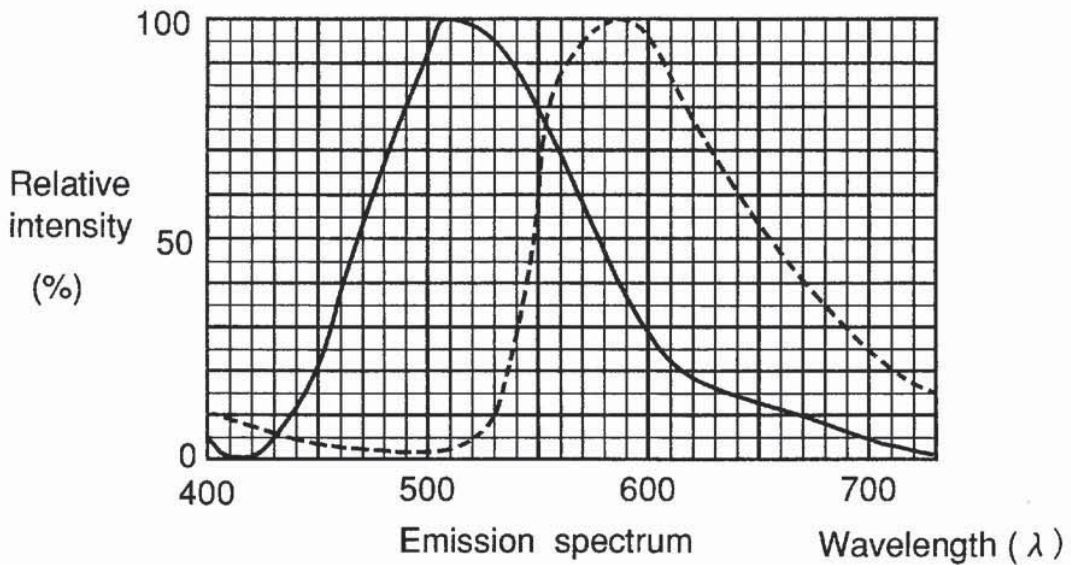


Fig.5B



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