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**Shmagin et al.**

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- [54] **OPTICAL INFORMATION STORAGE SYSTEMS AND METHODS USING HETEROSTRUCTURES COMPRISING TERNARY GROUP III-V NITRIDE SEMICONDUCTOR MATERIALS**
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- [58] **Field of Search** ..... 365/111, 114, 365/215; 359/7, 244, 248

- [56] **References Cited**
- U.S. PATENT DOCUMENTS**
- 5,499,206 3/1996 Muto ..... 365/114
- 5,508,829 4/1996 Freeouf et al. .... 359/3
- 5,521,398 5/1996 Pelekanos et al. .... 257/17
- 5,679,152 10/1997 Tischler et al. .... 117/97

- OTHER PUBLICATIONS**
- Beadie et al., "Persistent Photoconductivity in n-Type GaN", Appl. Phys. Lett., 71 (8), 25 Aug. 1997, pp. 1092-1094.
- Qiu et al., "Deep Levels and Persistent Photoconductivity in GaN Thin Films", Appl. Phys. Lett. 70 (15), 14 Apr. 1997, p. 1983.

Hirsch et al., "Persistent Photoconductivity in n-type GaN", Appl. Phys. Lett., 71 (8) 25 Aug. 1997, pp. 1098-1100.

Shmagin et al., "Optical Metastability in Bulk GaN Single Crystals", Appl. Phys. Lett., 71 (4), 28 Jul. 1997, pp. 455-457.

Joshkin et al., "Optical Memory Effect in GaN Epitaxial Films", Appl. Phys. Lett., 71, 1997.

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[57] **ABSTRACT**

Spatially localized radiation, preferably ultraviolet visible radiation, representing information is impinged onto a spatially localized area of a heterostructure comprising a ternary Group III-V Nitride semiconductor material. It has been found that the spatially localized radiation reversibly changes the properties of the heterostructure comprising ternary Group III-V Nitride semiconductor material in the spatially localized area, to thereby provide an optical memory. The stored information can be read from the memory by impinging blanket radiation, preferably ultraviolet radiation of the same frequency which was used to write the information, onto the heterostructure comprising ternary Group III-V Nitride semiconductor material including onto the spatially localized area thereof. Simultaneously, the changes in the properties of the heterostructure comprising ternary Group III-V Nitride semiconductor material in the spatially localized area as a result of the impinged blanket radiation are detected, to thereby read the information. Thus, high density, high contrast patterns can be written in spatially localized areas of a heterostructure comprising ternary Group III-V Nitride semiconductor material with ultraviolet light at room temperature and at cryogenic temperatures.

**37 Claims, 5 Drawing Sheets**

