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Schetzina

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[54] **INTEGRATED HETEROSTRUCTURES OF GROUP III-V NITRIDE SEMICONDUCTOR MATERIALS INCLUDING EPITAXIAL OHMIC CONTACT COMPRISING MULTIPLE QUANTUM WELL**

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Related U.S. Application Data

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[52] **U.S. Cl.** **257/96**; 257/190; 257/200

[58] **Field of Search** 257/190, 183, 257/200, 96

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[57] **ABSTRACT**

An integrated heterostructure of Group III-V nitride compound semiconductors is formed on a multicomponent platform which includes a substrate of monocrystalline silicon carbide and a non-nitride buffer layer of monocrystalline zinc oxide. The zinc oxide may be formed by molecular beam epitaxy (MBE) using an MBE effusion cell containing zinc, and a source of atomic oxygen, such as an MBE-compatible oxygen plasma source which converts molecular oxygen into atomic oxygen. An ohmic contact for a semiconductor device formed of Group III-V nitride compound semiconductor materials including a layer of aluminum nitride or aluminum gallium nitride, includes a continuously graded layer of aluminum gallium nitride and a layer of gallium nitride or an alloy thereof on the continuously graded layer. The continuously graded layer eliminates conduction or valence band offsets. A multiple quantum well may also be used instead of the continuously graded layer where the thickness of the layers of gallium nitride increase across the multiple quantum well. The ohmic contacts may be used for Group III-V nitride laser diodes, light emitting diodes, electron emitters, bipolar transistors and field effect transistors.

31 Claims, 27 Drawing Sheets

