

The Electrical Characteristics of TiO₂/Al₂O₃/TiO₂ nano-laminated thin film by Plasma Enhanced Atomic Layer Deposition

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The effects of insertion Al₂O₃ layer into TiO₂ on EOT and leakage current was investigated. The dielectric constant of TiO₂ is very high but its leakage current property is poor. In order to improve leakage current, Al₂O₃ layer is inserted into TiO₂ Film. As thickness of inserted Al₂O₃ layer increase, leakage current is decreased effectively because Al₂O₃ layer prevent Pool-Frenkel conduction mechanism. TiO₂(4nm)/Al₂O₃(1.2nm)/TiO₂(4nm) nano-laminated film was suggested as an optimal structure and that gave EOT=0.9nm and with a leakage current of 7×10^{-7} A/cm² at 1 V.

Keywords: high-k, TiO₂, Al₂O₃

Ag/AgAl ohmic reflector for high-performance near-UV GaN-based flip chip light emitting diodes

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GaN-based light emitting diodes(LEDs) having large output power is essential for solid-state lightening. But conventional top-emitting LED structures suffer from heat dissipation and current crowding problem caused by substrate and semi-transparent current spreading layer. To improve this problem, flip-chip LEDs having reflector at a p-type electrode are introduced. Ag is known to be the good reflector, while Ag suffers from thermal degradation (agglomeration and formation of voids above 300°C). Such problems were solved by several method. For example, transparent conducting oxide interlayers were used between Ag and p-GaN to increase thermal stability of Ag contacts.

In this work, we introduced Ag(200 nm)/AgAl(100 nm) ohmic contacts to p-type GaN for near-UV (405 nm) flip-chip LEDs. It is shown that the use of Ag/AgAl(8 at% Al) ohmic contacts results in better electrical and optical properties as compared to single Ag contacts when annealed at 430°C. For example, Ag/AgAl (8 at% Al) contacts give specific contact resistance of 4.6×10^{-4} Ωcm² and reflectance of 90% at a wavelength of 405 nm. However, use of an AgAl (with 50 at% Al) layer is not effective. LEDs fabricated with the Ag/AgAl (8 at% Al) reflectors produce higher light output as compared with the ones with single Ag reflectors. Ohmic mechanisms of the Ag/AgAl contacts are described and discussed by Auger electron spectroscopy(AES).

Keywords: GaN flip-chip light-emitting diode, AgAl reflector, Ohmic contact