

### The Electrical Characteristics of TiO<sub>2</sub>/Al<sub>2</sub>O<sub>3</sub>/TiO<sub>2</sub> nano-laminated thin film by Plasma Enhanced Atomic Layer Deposition

주대권, 전우진\*, 강상원†

한국과학기술원; \*Hynix  
(swkang@kaist.ac.kr†)

The effects of insertion Al<sub>2</sub>O<sub>3</sub> layer into TiO<sub>2</sub> on EOT and leakage current was investigated. The dielectric constant of TiO<sub>2</sub> is very high but its leakage current property is poor. In order to improve leakage current, Al<sub>2</sub>O<sub>3</sub> layer is inserted into TiO<sub>2</sub> Film. As thickness of inserted Al<sub>2</sub>O<sub>3</sub> layer increase, leakage current is decreased effectively because Al<sub>2</sub>O<sub>3</sub> layer prevent Pool-Frenkel conduction mechanism. TiO<sub>2</sub>(4nm)/Al<sub>2</sub>O<sub>3</sub>(1.2nm)/TiO<sub>2</sub>(4nm) nano-laminated film was suggested as an optimal structure and that gave EOT=0.9nm and with a leakage current of  $7 \times 10^{-7}$  A/cm<sup>2</sup> at 1 V.

**Keywords:** high-k, TiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>

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

김윤한, 황윤태\*, 홍현기, 나현석, 오준호, 김강원, 전준우, 김용현, 윤주현, 성태연†

고려대학교; \*Univ. of California at Santabarbara  
(tyseong@korea.ac.kr†)

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  $4.6 \times 10^{-4}$  Ωcm<sup>2</sup> 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