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Formation of Plasma Damage-Free ITO Thin Flims on the InGaN/GaN based LEDs by Using Advanced Sputtering

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GaN based light emitting diodes (LEDs) are important devices that are being used extensively in our daily life. For example, these devices are used in traffic light lamps, outdoor full-color displays and backlight of liquid crystal display panels. To realize high-brightness GaN based LEDs for solid-state lighting applications, the development of p-type ohmic electrodes that have low contact resistivity, high optical transmittance and high refractive index is essential. To this effect, indiumtin oxide (ITO) have been investigated for LEDs. Among the transparent electrodes for LEDs, ITO has been one of the promising electrodes on p-GaN layers owing to its excellent properties in optical, electrical conductivity, substrate adhesion, hardness, and chemical inertness. Sputtering and e-beam evaporation techniques are the most commonly used deposition methods. Commonly, ITO films on p-GaN by sputtering have better transmittance and resistivity than ITO films on p-GaN by e-bam evaporation. However, ITO films on p-GaN by sputtering have higher specific contact resistance, it has been demonstrated that this is due to possible plasma damage on the p-GaN in the sputtering process. In this paper, we have investigated the advanced sputtering using plasma damage-free p-electrode. Prepared the ITO films on the GaN based LEDs by e-beam evaporation, normal sputtering and advanced sputtering. The ITO films on GaN based LEDs by sputtering showed better transmittance and sheets resistance than ITO films on the GaN based LEDs by e-beam evaporation. Finally, fabricated of GaN based LEDs by using advanced sputtering. And compared the electrical properties (measurement by using C-TLM) and structural properties (HR-TEM and FE-SEM) of ITO films on GaN based LEDs produced by e-beam evaporation, normal sputtering and advanced sputtering. As a result, It is expected to form plasma damage free-electrode, and better light output power and break down voltage than LEDs by e-beam evaporation and normal sputter.

Keywords: Plasma damage, Sputter, ITO, GaN based LED