

## Recovery of Electrical Properties by Surface Treatment after Mesa Etching in InGaN/GaN Multiple Quantum Well Light Emitting Diodes

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To recover electrical properties of an InGaN/GaN multiple quantum well lighting emitting diode after mesa etching by Inductively Coupled Plasma (ICP), a surface treatment using ultrasonically BOE and ammonium sulfide  $(\text{NH}_4)_2\text{S}_x$  has been performed. After the surface treatment, surface smoothness of p-GaN and n-GaN layers was improved, and the operating voltage ( $V_{op}$ ). It was found that an increase in roughness of the n-GaN layer increases the operating voltage ( $V_{op}$ ), but that of the p-GaN layer decreases  $V_{op}$ . This is because an increase in the surface roughness decreases the contact resistance between metal and GaN layers in the p-GaN layer, but it increases resistance due to an increase of current path in the n-GaN layer.