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Efficiency Improvement in InGaN-Based Solar Cells by Indium Tin Oxide Nano Dots Covered with ITO Films

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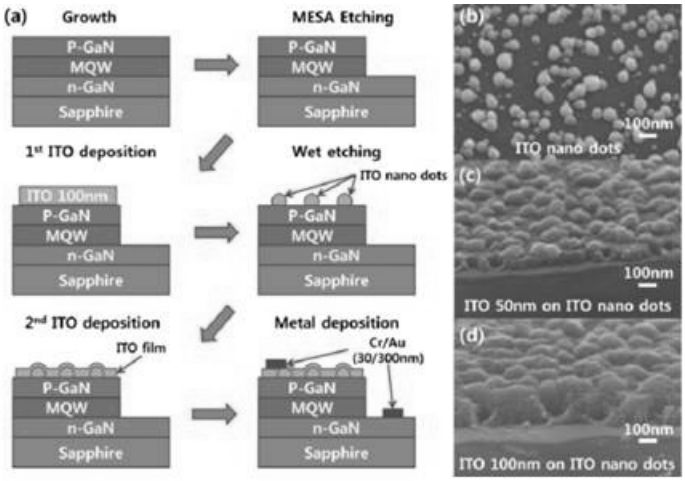
InGaN material is being studied increasingly as a prospective material for solar cells. One of the merits for solar cell applications is that the band gap energy can be engineered from 0.7 eV for InN to 3.4 eV for GaN by varying of indium composition, which covers almost of solar spectrum from UV to IR. It is essential for better cell efficiency to improve not only the crystalline quality of the epitaxial layers but also fabrication of the solar cells. Fabrication includes transparent top electrodes and surface texturing which will improve the carrier extraction. Surface texturing is one of the most employed methods to enhance the extraction efficiency in LED fabrication and can be formed on a p-GaN surface, on an N-face of GaN, and even on an indium tin oxide (ITO) layer. Surface texturing method has also been adopted in InGaN-based solar cells and proved to enhance the efficiency. Since the texturing by direct etching of p-GaN, however, was known to induce the damage and result in degraded electrical properties, texturing has been studied widely on ITO layers. However, it is important to optimize the ITO thickness in Solar Cells applications since the reflectance is fluctuated by ITO thickness variation resulting in reduced light extraction at target wavelength. ITO texturing made by wet etching or dry etching was also revealed to increased series resistance in ITO film. In this work, we report a new way of texturing by deposition of thickness-optimized ITO films on ITO nano dots, which can further reduce the reflectance as well as electrical degradation originated from the ITO etching process.

Keywords: InGaN, Solar cells, LEDs, ITO nano dots, ITO thickness



[Processing Steps and SEM images of ITO nano dots]