Etching Study of GaN by Photoelectrochemical Reaction Method

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ABSTRACT

In this thesis, wet etching of GaN by photoelectrochemical (PEC) technique was investigated and applied to the fabrication of light emitting diodes. In order to develop a suitable wet etching process for the device fabrication, studies of wet etching of GaN included the adoption of H3PO4 and KOH with different concentrations and the effect of external bias on the etching rate and the surface morphology. In this study, the wet etching of GaN was based on the configuration of PEC technique. An external bias was utilized to build up an electrical field between electrolyte and semiconductor to attract large amount of holes moving toward surface and therefore enhance the rates of oxidation and etching. With 0.1M H3PO4, the etching rates were 30nm/min, 73nm/min, and 85nm/min for 0, 1, and 2V bias, respectively. With 0.08M KOH, the etching rates were 52nm/min, 1018nm/min, and 1122nm/min for 0, 1, and 2V bias, respectively. On the other hand, the surface morphology of the etched samples was examined by scanning electron microscopy (SEM). With external bias, lot of needles was observed on the surface of the sample etched with low concentration of electrolyte. And, the surface morphology became poorer with increasing the concentration of electrolyte. Relatively, the better surface was obtained from the sample etched with high temperature and high concentration KOH solution without bias, even the etching rate was low. In order to develop a wet etching process with reasonable etching rate and good surface morphology, the samples etched with bias and low concentration of electrolyte were further treated with high temperature and high concentration KOH solution. We found that the needle on the surface could be removed, and hence, the surface morphology was improved. Beside, good quality of ohmic contact could be formed on the PEC etched n-GaN surface with a suitable de-oxide process.

Keywords : n-GaN ; photoelectrochemical ; bias

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