Growth of Ga2O3 on n-GaN by Photoelectrochemical Oxidization

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ABSTRACT

Oxide of semiconductor could be a part of device structure, like MOS structure, or a layer to provide the surface passivation. With the great progress of the applications of GaN on optoelectronic devices and high temperature/high power electronics, GaN is more attractive than ever. Dry or wet thermal oxidation process is a mature technology for the oxidation of silicon. However, it has only limited success on GaN. High temperature process will deteriorate the crystal quality of GaN and further degrade the performance of devices. In this thesis we studied the growth of Ga2O3 oxide film on n-type GaN by photoelectrochemical oxidization (PECO) technique. The first, in order to enhance the oxidation rate, we tried to conduct the wet oxidation of GaN in various concentrations of phosphorus acid (H3PO4) solutions with 0, 1, or 2V bias. The tested samples were examined with α-step profiler、scanning electron microscopy (SEM) and energy dispersive spectrometer (EDX) to evaluate the oxide thickness、the surface morphology and the composition of oxide, respectively. We obtained that the growth rates of oxide with 0.0032M phosphorus acid solution were 224nm/h, 2.8μm/h, and 5μm/h for 0, 1, or 2V bias, respectively. Also, the oxygen atom ratio in the oxide increased with bias from EDX analysis. Hence, an external bias could be used to enhance the oxidation rate of GaN and the growth rate of oxide. In order to evaluate the properties of oxides, the PECO grown oxides were applied to the fabrication of MOS on GaN. Both I-V and C-V measurements were used to characterize the MOS devices. During process, we found the as-grown oxide must be annealed under high temperature to prevent the attack of chemicals during process.

Keywords : GaN ; photoelectrochemical oxidization ; Ga2O3

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