Optical Properties of GaN Films Etched in Inductively Coupled Plasmas

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GaN 박막의 ICP 식각후의 광특성

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ABSTRACT

As-grown undoped, Si-doped n- and Mg-doped p-type GaN films has been etched with chlorine-based inductively coupled plasmas (ICPs). The effect of plasma parameters on optical properties of GaN films etched in Cl_2/Ar discharges was studied. The GaN films were grown at 1100 °C on Al_2O_3 substrates by metal organic chemical vapor deposition (MOCVD). The thickness of the epitaxial GaN layer was about 1.5 μm. Photoluminescence (PL) measurements were made at room temperature using a He-Cd (325 nm) laser as the excitation source. The surface roughness was relatively independent of the rf power up to 150 W, resulting in quite smooth morphology (rms roughness 1.1 – 1.3 nm), while etching at higher chuck powers (> 200 W) produced rougher surface due to increased ion bombardment. The lattice disorder and point defects were much less generated during the ICP etching than reactive ion etching (RIE). Compared to the PL intensity of as-grown n-GaN, the intensity of the band edge peak was decreased after the ICP etching, but the extent of intensity decrease was inversely proportional to the applied chuck power. By contrast, the YL peaks were relatively independent of the ion energy except at 50 W, and showed a red shift to 562 nm. The as-grown p-GaN showed a weak PL intensity of band edge emission (366 nm), but the peak shifted to 460 nm after etching with showing substantial increase in PL intensity with rf chuck power. The mechanism of PL intensity enhancement of the p-GaN was also discussed in terms of transition schemes involving the Mg-related deep level.

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