The Korean Institute of Surface Engineering, Fall Meeting, Seoul, Korea, October, 1999

Magnetized inductively coupled plasma etching of GaN in Cl_2/BCl_3 plasmas

Y.H.Lee[a], Y.J.Sung, and G.Y.Yeom[b]

Department of Materials Engineering, Sungkyunkwan University, Suwon, 440-746, Korea

In this study, Cl_2/BCl_3 magnetized inductively coupled plasmas (MICP) were used to etch GaN and the effects of magnetic confinements of inductively coupled plasmas on the GaN etch characteristics were investigated as a function of Cl_2/BCl_3. Also, the effects of Kr addition to the magnetized Cl_2/BCl_3 plasmas on the GaN etch rates were investigated. The characteristics of the plasmas were estimated using a Langmuir probe and quadrupole mass spectrometry (QMS). Etched GaN profiles were observed using scanning electron microscopy (SEM). The small addition of BCl_3 (10-20%) in Cl_2 increased GaN etch rates for both with and without the magnetic confinements. The application of magnetic confinements to the Cl_2/BCl_3 inductively coupled plasmas (ICP) increased GaN etch rates and changed the Cl_2/BCl_3 gas composition of the peak GaN etch rate from 10% BCl_3 to 20% BCl_3. It also increased the etch selectivity over photoresist, while slightly reducing the selectivity over SiO_2. The application of the magnetic field significantly increased positive BCl_2^+ measured by QMS and total ion saturation current measured by the Langmuir probe. Other species such as Cl, BCl, and Cl^+ were increased while species such as BCl_2 and BCl_3 were decreased with the application of the magnetic field. Therefore, it appears that the increase of GaN etch rate in our experiment is related to the increased dissociative ionization of BCl_3 by the application of the magnetic field. The addition of 10% Kr in an optimized Cl_2/BCl_3 condition (80% Cl_2/ 20% BCl_3) with the magnets increased the GaN etch rate about 60%. More anisotropic GaN etch profile was obtained with the application of the magnetic field and a vertical GaN etch profile could be obtained with the addition of 10% Kr in an optimized Cl_2/BCl_3 condition with the magnets.

[a] Electronic mail: yhlee-msk@hanmail.net
[b] Electronic mail: gyyeom@yurim.skku.ac.kr