Growth and characterization of MgZnO grown on R-plane sapphire substrate by plasma-assisted molecular beam epitaxy

Seok Kyu Han, Jung-Hyun Kim, Soon-Ku Hong, Jae Wook Lee*, Jeong Yong Lee*, Ho Jong Kim**, Jung-Hoon Song**, Takafumi Yao***

Chungnam National University, KAIST*, Kongju National University**, Tohoku University***

Abstract : ZnO has received considerable attention due to its potential applicability to optoelectronic devices such as ultraviolet-light emitting diodes (UVLEDs) and laser diodes (LDs). As well known, however, polar ZnO with the growth direction along the c-axis has spontaneous and piezoelectric polarizations that will result in decreased quantum efficiency. Recently, nonpolar ZnO has been studied to avoid such a polarization effect. In order to realize applications of nonpoar ZnO-based films to LEDs, growth of high quality alloys for quantum well structures is one of the important tasks that should be solved. $Mg_XZn_{1-X}O$ and $Cd_XZn_{1-X}O$ is ones of most promising alloys for this application because the alloys of ZnO with MgO and CdO provide a wide range of band-gap engineering spanning from 2.4 to 7.8 eV. In this study, we investigated on $Mg_XZn_{1-X}O$ films grown with various Mg/Zn flux ratios The films were grown on R-plane sapphire substrates by plasma-assisted molecular beam epitaxy (PAMBE). we investigated on $Mg_XZn_{1-X}O$ films grown with various Mg/Zn flux ratios. The films were grown on R-plane sapphire substrates by plasma-assisted molecular beam epitaxy (PAMBE). With the relatively low Mg/Zn flux ratios, a typical striated anisotropic surface morphology which was generally observed from the nonpolar (11-20) ZnO film on r-plane sapphire substrates. By increasing the Mg/Zn flux ratio, however, additional islands were appeared on the surface and finally the surface morphology was entirely changed, which was generally observed for the (0001) polar ZnO films by losing the striated morphology. Investigations by X-ray Θ-2Θ diffraction revealed that (0002) and (10-11) ZnO planes are appeared in $Mg_XZn_{1-X}O$ films by increasing the Mg/Zn flux ratio. Further detailed investigation by transmission electron microscopy (TEM) and photoluminescence (PL) will be discussed.

Key Words : Zinc oxide, Molecular beam epitaxy, Zinc compound, Characterization, Semiconductiong II-VI materials