【T-29】

Photoluminescence of Al-doped ZnO thin film growth on Al_2O_3 (0001) substrate through rapid thermal annealing in N_2 and H_2 atmosphere

Jeong Cho*, Jong-Bum Nah, Min-Seok Oh, Jae-Hoon Song, Ki-Hyun Yoon*,
Hyung-Jin Jung, and Won-Kook Choi
Thin Film Technology Research Center, Korea Institute of Science and Technology,
Cheongryang P.O. Box 131, Seoul 136-791, Korea
*Department of Ceramic Engineering, Yonsei University, Sudaemoon-Ku 131, Seoul, Korea

2wt% Al_2O_3-doped ZnO (AZO) thin films were deposited on α-Al_2O_3 (0001) single crystal substrate by parellel type rf magnetron sputtering at 550℃. The as-grown AZO thin films were polycrystalline and shows only broad deep defect-level photoluminescence (PL). In order to examine the change of PL property after thermal annealing, AZO thin films were annealed in N2 (N-AZO) and H2 (H-AZO) in the temperature 600-1000℃ through rapid thermal process. After annealing 800℃, N-AZO shows near band edge emission (NBE) with very small deep-level emission, and then N-AZO annealed at 900℃ shows only sharp NBE with 219 meV FWHM. Compared to N-AZO, H-AZO exhibits very interesting PL characteristic features. After 600℃ annealing, deep defect-level emission was quite quenched and NBE around 382 nm (3.2 eV) was observed, which can be explained by the H_2 passivation effect. At elevated temperature, two interesting peaks corresponding to violet (406 nm, 3.05 eV) and blue (436 nm, 2.84 eV) emission was firstly observed in AZO thin films. Based-on defect-level scheme calculated by using the full potential linear muffin-tin orbital (FP-LMTO), the emission 3.2 eV, 3.05 eV, and 2.84 eV of H-AZO are substantially deginated as exciton emission, transition from conduction band maximum to V_{Zn}, from Zni to valence band maximum (VBM), respectively.