

[ZnO-06]

Crystallinity-damage recovery and optical property in As-doped p-type ZnO induced by ion implantation

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As-doped p-type ZnO has been achieved by ion implantation. For the crystallinity recovery of the surface damage and the activation of the As dopant, these ZnO samples were carried out the post-implantation annealing. From the measurements of the double crystal x-ray diffraction, the atomic force microscopy, the Raman scattering, and the photoluminescence (PL), we know that the optimum temperature on the post-implantation annealing is 800 °C. Thus, from the Raman experiment after the ion implantation, peaks of the E_2^{high} mode shifted toward the higher energy side of the spectrum by 0.55 cm^{-1} . This result indicates that the stress increment of the sample surface due to the implantation may be a possible reason for the blueshift of the Raman lines. From the PL spectra on temperature of 13 K, the As-related emissions due to As ion implantation were observed. The peak at 3.3589 eV, which is associated with the neutral acceptor bound exciton (A^0, X), is the most dominant among these. In addition, the free electrons and acceptor holes (FA) and donor-acceptor pairs (DAP) emissions related to As are observed at 3.3159 and 3.1859 eV, respectively. Thereby, we confirmed that the surface of the undoped ZnO was clearly converted into the As-doped p-type ZnO layer by As ion. Also, from the I-V characteristic experiment, we clearly observed to the behavior of rectifying from the p-n junction.