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Synthesis and characterization of P-doped ZnO and (Zn,Mg)O thin films for optoelectronic applications YUANJIE LI, HYUNKSOO YANG, JEAN ERIE, HYUNSIK KIM, STEPHEN PEARTON, DAVID NORTON, DEPT. OF MATERIALS SCIENCE AND ENGINEERING, UNIVERSITY OF FLORIDA COLLABORATION — ZnO is attracting much attention for its applications in optoelectronic devices due to its wide direct band gap of 3.3 eV and a strong excitonic binding energy of 60 meV. In addition, the band gap of ZnO can be tuned in the range of 3.0 eV - 4.0 eV via alloying with CdO and MgO, which open opportunities for band gap engineering. However, the development of ZnO-based optoelectronic devices has been hindered by achieving low resistivity, high carrier density p-type ZnO. In this study, p-type conductivity in phosphorus-doped (Zn,Mg)O films grown via pulsed laser deposition (PLD) were achieved by adjusting the oxygen partial pressure during the deposition. A hole concentration of 2.7×10^{16} $cm^{-3}$and mobility of 8.2 cm^2/Vs were determined from van der Pauw Hall measurements for p-type (Zn,Mg)O:P films. The p-(Zn,Mg)O:P/n-ZnO heterostructures were fabricated on single crystal ZnO. Rectifying characteristics were shown in the vertical structure, confirming the presence of a p-n junction. The systematic study of the relationship of doping concentrations, growth conditions with the transport and optical properties for P-doped ZnO films will also be discussed. R. T. photoluminescence, X-ray diffraction (XRD) and Atomic Force Microscopy (AFM) were utilized to characterize the films properties.

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