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Cu-Doping of ZnO by Nuclear Transmutation and Electrical and Optical Characterization of Cu Acceptors[1]

FARIDA SELIM, MARIANNE TAURN, JIANFENG JI, DONALD WALL, Washington State University, LYNN BOATNER, Oak Ridge National Laboratory, MATTHEW MCCLUSKEY, Washington State University, SELIM TEAM[2], COLLABORATION WITH MCCLUSKEY GROUP COLLABORATION, BOATNER COLLABORATION, WALL COLLABORATION — Cu doping is known to have a large effect on the electrical and optical properties of ZnO, its role is different from other dopants, and a fundamental understanding of this role is lacking. One problem of ZnO doping is arising from the difficulty in controlling dopant locations in conventional doping methods. In this work we doped Zn single crystals with copper acceptors by means of the nuclear transmutation doping (NTD) method, which gives highly uniform dopant distributions and has a much higher probability of controlling the dopant locations in the lattice. The Cu doping was confirmed by the infrared absorption signature of Cu^{2+} at 5780 cm^{-1}. Hall-effect measurements indicated that the Cu acceptor level lies 0.160 eV below the conduction band minimum. With respect to optical properties, an interesting low-temperature thermal stimulated luminescence has been observed in as-grown and doped ZnO single crystals. This low-temperature luminescence can reveal the density of donors and acceptors in ZnO and their location in the band gap.

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