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Lithium Acceptors and Hydrogen in Zinc Oxide CALEB COROLEWSKI, MATTHEW MCCLUSKEY, Washington State University — Zinc Oxide, a wide-direct-bandgap semiconductor, is predominantly n-type. Realization of p-type material coupled with high efficiency UV emission could provide efficient solid state lighting. In this study we developed a diffusion process to maximize the Li acceptor concentration in ZnO crystals. We provide evidence for weak p-type conduction in Li-doped ZnO. SIMS measurements show the Li concentration increases from 5×10^{17} to 3×10^{19} cm^{-3} and is constant for the 16 μm measured, indicating bulk doping was achieved. Photoluminescence (PL) spectra show the characteristic yellow band for an 800 meV Li acceptor, and an additional blue band. The 800 meV Li acceptor has a 3.1 eV onset for optical excitation. Fourier transform infrared spectroscopy measurements show defect local vibrational modes corresponding to a 3326.8 cm^{-1} line, the 3577 cm^{-1} Li-OH, and the 3677 cm^{-1} surface OH monolayer. The intensity ratios of the 3326.8 cm^{-1} to the 3677 cm^{-1} lines and of the blue to yellow PL bands depends on the presence of Zn in dopant source and are therefore Zn vacancy related. Van der Pauw resistivity measurements show Li-doped crystals to be insulating (10^9 $\Omega\cdot$ cm) at room temperature. Above 400 K the resistivity drops due to the increased concentration of free holes, consistent with thermal ionization of Li acceptors. Modeling the data determined a defect ionization energy of 880 meV. The magnitude and behavior of the resistivity with temperature is consistent with highly resistive and weakly p-type ZnO.

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