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Transparent Conducting ZnO Thin Films Doped with Al and Mo

JOEL DUENOW, Colorado School of Mines, TIMOTHY GESSERT, National Renewable Energy Laboratory, DAVID WOOD, Colorado School of Mines, DAVID YOUNG, TIMOTHY COUTTS, National Renewable Energy Laboratory — Transparent conducting oxide (TCO) thin films are a vital part of photovoltaic cells, flat-panel displays, and electrochromic windows. ZnO-based TCOs, due to the relative abundance of Zn, may reduce production costs compared to those of the prevalent TCO In_2O_3:Sn (ITO). Undoped ZnO, ZnO:Al (0.5, 1, and 2 wt.% Al_2O_3), and ZnO:Mo (2 wt.%) films were deposited by RF magnetron sputtering. Optimal deposition temperature was found to be 200^oC. Controlled incorporation of H_2 in the Ar sputtering ambient increased mobility of undoped ZnO significantly to 48 $cm^2V^{-1}s^{-1}$. H_2 also appears to catalyze ionization of dopants. This enabled lightly doped ZnO:Al to provide comparable conductivity to the standard 2 wt.%-doped ZnO:Al while demonstrating reduced infrared absorption. Mo was found to be an n-type dopant of ZnO, though material properties did not match those of ZnO:Al. Scattering mechanisms were investigated using temperature-dependent Hall measurements and the method of four coefficients. This abstract is subject to government rights.

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