Abstract Submitted
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Highly Efficient Defect Emission from ZnO and ZnO:S JAY SIMMONS, Department of Chemistry, Duke University, Durham, North Carolina 27708, JOHN FOREMAN, U.S. Army Aviation and Missile Research Development and Engineering Center, Redstone Arsenal, Al 35898, JIE LIU, Department of Chemistry, Duke University, Durham, North Carolina 27708, HENRY EVERITT, Department of Physics, Duke University, Durham, North Carolina 27708 — Bulk Zinc Oxide (ZnO) is a wide, direct band gap semiconductor with an energy of 3.4 eV that contains two emission bands: the UV band-edge emission and the green defect emission band. We have shown that the external quantum efficiency of the green band can exceed 50%. To investigate the mechanism of efficient defect emission, vacuum annealed (ZnO:Zn) and sulfur-doped (ZnO:S) ZnO were investigated because of their strong defect emission and suppressed UV band edge emission. Continuous wave low temperature photoluminescence (PL) and PL excitation (PLE) spectra were measured for the two compounds. It was found that bound excitons, not free photoexcited carriers, mediate the defect emission in ZnO:Zn, while the defect emission from ZnO:S seems to originate from a Zn-S complex formed in the crystal lattice. Temperature-dependent PLE spectra for the defect and band edge emission were measured to estimate trapping and activation energies of the bound excitons. XPS and X-Ray diffraction studies were also performed to ascertain the concentration and nature of sulfur doping in the ZnO lattice. The results presented here offer hope that engineering defects in ZnO materials may significantly improve the quantum efficiency for white light phosphor applications.

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