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Origins of Luminescence and Scintillation in Un – Doped Single Crystal Zinc Oxide A. M. COLOSIMO, J. JI, P. S. STEPANOV, Bowling Green State Univ, W. ANWAND, A. WAGNER, Institute of Radiation Physics, Helmholtz-Zentrum Dresden-Rossendorf, L. A. BOATNER, Materials Science and Technology Division, Oak Ridge National Laboratory, F. A. SELIM, Bowling Green State Univ — The origins of the luminescence and scintillation properties of zinc oxide are studied by means of photo – luminescence (PL), X – ray induced luminescence (XRIL) [Review of Scientific Instruments 83, 103112(2012)], gamma – induced positron spectroscopy (GIPS), and scintillation counting measurements such as coupling the ZnO crystals to a photomultiplier tube (PMT) to measure rise times and collect spectra. The ultra-violet and green emissions in single crystal ZnO are probed by X – ray excitation, and XRIL data exhibits an excellent linear relationship between the increase in the ZnO emission intensity and the increase in X – ray tube current. Rise times and scintillation counting spectra were measured from the anode and dynode signals of the PMT, respectively, with sub – nanosecond rise times acquired. This combination of the scintillation counting and XRIL measurements revealed a strong correlation between the fast scintillation in the single crystal ZnO and the ratio between the defect luminescence (DL) and near band emission (NBE). GIPS is a sensitive method of measuring cation vacancies in semiconductors, and the unique defect spectroscopy method enables collection of positron lifetime decay curves for the ZnO samples, free of background and source contributions.

A. M. Colosimo
Bowling Green State Univ

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