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Novel Application of a Gaussian Model of the Band-Edge in the Study of Defect Dynamics in ZnO Thin Film AMRAH CANUL, DINESH THAPA, JEFFREY LAPP, JESSE HUSO, LEAH BERGMAN, University of Idaho
— The Urbach model and band-edge analysis in UV-Vis absorption spectra has been at the forefront of investigations into the defect physics of ZnO thin films and many other materials. A unique combination of differential and deconvolution analysis shows that the basic Urbach model is not sufficient to accurately model the differential band-edge in ZnO thin film. To do so, we employ the small addition of a Gaussian term to the basic Urbach model. With this Gaussian model, we extract directly from the spectra parameters such as the unperturbed band-edge, E_o, and the spread in bandgap energies due to the defect distribution, w. We provide substantial experimental support for defining the physical parameters as such, including independent XRD studies. Furthermore, we illustrate an application of this model and analytical approach in the study of defect dynamics in ZnO. Through a series of annealing treatments we show strong evidence for activation of grain growth at 400 C. Finally, we show the distinct separation of ZnO thin film thermo-optical properties, band-edge redshifting and broadening into an amorphous and a crystalline regime.

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