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The Optical Blueshift Saturation Behavior of $\text{Mg}_x\text{Zn}_{1-x}\text{O}$ Films

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A phenomenon of blueshift saturation was observed from cathodoluminescence (CL) spectra of $\text{Mg}_x\text{Zn}_{1-x}\text{O}$ films ($0.069 \leq x \leq 0.8$) that were grown by pulsed laser deposition technology. By analyzing the results of composition-dependent X-ray diffraction spectra, scanning electron microscopy images, absorption spectra, and CL spectra, the crystalline structural disorder was determined via Urbach energy value. Furthermore, a competition mechanism between band-filling effect and band tail states was proposed in the composition-dependent CL spectra. This competition is believed to be responsible for the composition-induced blueshift saturation often observed in the disordered alloy semiconductors. The results of this research can provide important reference in energy-band engineering.

Keywords: $\text{Mg}_x\text{Zn}_{1-x}\text{O}$, luminescence, Urbach energy, band tail state.