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ZnO nanowire-based light-emitting diodes with tunable emission from near-UV to blue

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Abstract

The bandgap engineering of ZnO nanowires by doping is of great importance for tunable light emitting diode (LED) applications. We present a combined experimental and computational study of ZnO doping with Cd or Cu atoms in the nanomaterial. Zn1-xTMxO (TM=Cu, Cd) nanowires have been epitaxially grown on magnesium-doped p-GaN by electrochemical deposition. The Zn1-xTMxO/p-GaN heterojunction was integrated in a LED structure. Nanowires act as the light emitters and waveguides. At room temperature, TM-doped ZnO based LEDs exhibit low-threshold emission voltage and electroluminescence emission shifted from ultraviolet to violet-blue spectral region compared to pure ZnO LEDs. The emission wavelength can be tuned by changing the transition metal (TM) content in the ZnO nanomaterial and the shift is discussed, including insights from DFT computational investigations.