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Rare-earth doped Si-rich ZnO for multiband near-infrared light emitting devices EMANUELE FRANCESCO PECORA, THOMAS IAN MURPHY, LUCA DAL NEGRO, Boston University — Transparent Conductive Oxides (TCOs) are a broad class of organic and inorganic materials exhibiting both optical transparency and electrical conductivity simultaneously. TCOs are utilized as top-con tact passive layers in a number of optoelectronic devices, including flat panel displays and solar cells. Recently, they are also attracting considerable attention as an active platform for a wide range of novel device applications. Zinc oxide (ZnO) is the most promising candidate for optoelectronic integration due to its low cost and Si compatibility. Moreover, it is a biocompatible material and possibly biodegradable. We fabricated rare earth-doped Si-rich ZnO thin films through magnetron sputtering and we investigate their near-infrared emission properties under both optical and electrical injection. Er and Nd efficient (3ms RT lifetime) radiative transitions were simultaneously activated due to energy transfer via the ZnO direct bandgap and its luminescent defect centers. Moreover, by incorporating Si atoms, we demonstrate Si-mediated enhancement of light emission in Er-doped ZnO, and electroluminescence. We fabricated a proof-of-concept 1.55μm-electroluminescent device with record low turn-on voltage (<1.5V) in Er-doped Si-rich ZnO at room temperature. These results pave the way to novel Si-compatible light emitters that leverage the optically transparent and electrically conductive ZnO matrix for multiband near-IR telecom and bio-compatible applications.

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