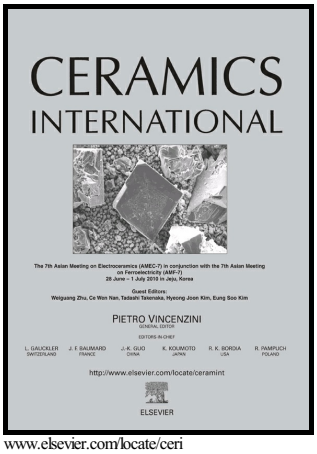

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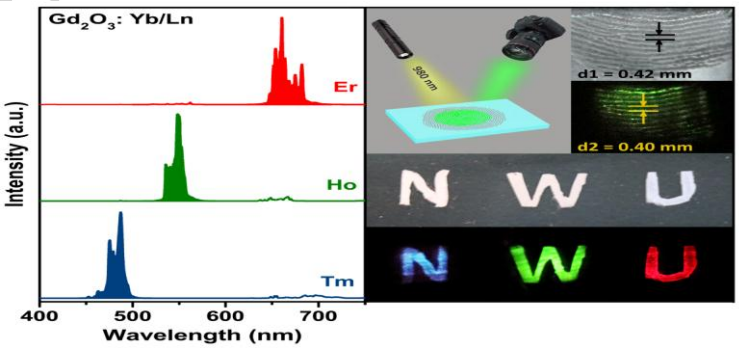
Abstract

Self-assembled three-dimensional Yb^{3+}/Ln^{3+} (Ln = Er, Ho, Tm) co-doped Gd_2O_3 up-converted (UC) phosphors were synthesized by a facile co-precipitation method, *and their morphologies* and microstructures were investigated by scanning electron microscope (SEM) and transmission electron microscope (TEM) analysis. Under the excitation at 980 nm, spectral pure three primary colors red, green and blue (RGB) emissions were *respectively* achieved in Yb^{3+}/Er^{3+}, Yb^{3+}/Ho^{3+} and Yb^{3+}/Tm^{3+} co-doped Gd_2O_3 phosphors, in which spectral color purities were tuned by adjusting the doping concentration, annealing temperature, excitation power density and *the pulse-width of 980 nm laser*. These results provide deeper insights into modulating spectral color purities of up-converted emission, and the potential *applications* of spectrally pure RGB up-converted materials in fingerprint recognition and multi-color printing were also investigated.

Graphical abstract



The spectral pure RGB up-converted emissions towards fingerprint recognition and multi-color printing