
Fabrication and Characterization of High-Quality Films and Nanopatterns of Upconversion Materials

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We demonstrate a successful fabrication of high-quality films and nanopatterns of upconversion materials via a sol-gel and soft lithography. Understanding the thermal, chemical, structural properties of precursor solution was crucial for the successful fabrication. The fabricated polycrystalline films have a hexagonal phase and a smooth surface ($R_a = 3.4$ nm). The emission colors of the films under 980 nm excitation can be tuned for yellow, green, and blue by adjusting dopant types and concentrations. The sol-gel process is compatible with the fabrication of nanopatterns which enhance the upconversion emission intensity by improving light out-coupling efficiency. We believe that our demonstration is important for the development of science and technology in various research fields such as displays, optoelectronics, photonics, and photovoltaics.

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