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Upconversion Luminescence Properties of Different Fluoride Matrix Materials NaREF₄ (RE: Gd, Lu, Y) Doped with Er³⁺/Yb³⁺

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Abstract: The densities of state and optical properties of matrix materials were studied with the help of first-principles calculations. It is found that the absorption and reflectance of the NaGdF₄ system in the infrared region were comparatively low. Such low values were beneficial to the reduction of the loss of excitation light. Furthermore, Er³⁺ and Yb³⁺ co-doped NaREF₄ (RE: Gd, Lu, Y) were prepared by a simple hydrothermal method, which exhibited a regularly shaped hexagonal microrods. Under the excitation of 808 nm, 980 nm, 1064 nm and 1550 nm, three emission peaks were all observed at 521, 540 and 655 nm for these samples, and NaGdF₄: Yb/Er has the highest fluorescence intensity among the three samples. Calculated and experimental results demonstrated that NaGdF₄ is more suitable than the two other materials as a substrate for UC luminescence.

Keywords: First-principles; Upconversion; NaREF₄; Hydrothermal

1. Introduction

Upconversion (UC) is an anti-Stokes-type emission that involves the sequential absorption of two or more photons, leading to the emission of light at a wavelength shorter than the excitation wavelength^[1]. Rare earth elements have an unfilled 4f electron layer, shielded by an outer electron

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