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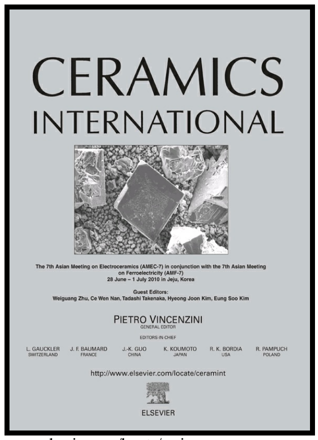

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Observation of efficient Er^{3+}:$^4I_{11/2}$→$^4I_{13/2}$ transition in highly Er^{3+} doped germanosilicate glass

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ABSTRACT: Highly rare earth（RE）ions doped glass laser materials can produce efficient single frequency mid-infrared laser. In this work, a series germanosilicate glasses with various high erbium-doping concentration (up to 4 mol%) and without concentration quenching are fabricated. Spectroscopic properties and energy transfer (ET) mechanism of efficient Er^{3+}:$^4I_{11/2}$ →$^4I_{13/2}$ transition have been investigated in detail upon a conventional 980 nm Laser Diode. The dense structure of silicate glass can be dissolved effectively by the introduction of GeO_2, which was analyzed by Raman spectra, so that the compatibility and luminous intensity of RE ions were improved. The high predicted spontaneous transition probability (A_{rad}=37.65 s^{-1}) based on the Judd-Ofelt theory and large calculated emission cross section (8.8×10^{-21} cm^2) are obtained. The above results indicate that these glasses are promising to be the single frequency mid-infrared laser material.

Keywords: Germanosilicate glasses; Er^{3+} ions; 2.7 μm emission; Energy transfer.

1. Introduction

For the reasons that RE ions doped glass laser materials can produce mid-infrared laser, which are applied to biological medicine, remote sensing communication, environmental monitoring, military weapons and so on[1-5]. Single frequency laser needs to make the cavity be short, and the laser beam spacing can be increased by the shorter fiber length (short to 1~2 cm) to let laser output catch more attention[6]. Because the length of the cavity is short, it requires high gain per unit length medium. Thus, in order to obtain the efficient mid-infrared laser, high RE concentration is necessary. As well known, Er^{3+} is the primary dopant for high doping in glasses[7, 8], because of Er^{3+} possesses rich energy level structure and can be pumped by commercial 980 or 808 nm Laser Diode (LD) laser directly.

Previous efforts on highly Er^{3+} doped hosts are mainly concentrated on the fluoride matrix, which