

# Accepted Manuscript

Growth, structure and spectroscopic properties of melilite Er: CaLaGa<sub>3</sub>O<sub>7</sub> crystal for use in mid-infrared laser

Yunyun Liu, Yan Wang, Zhenyu You, Jianfu Li, Zhaojie Zhu, Chaoyang Tu



PII: S0925-8388(17)30714-4

DOI: [10.1016/j.jallcom.2017.02.266](https://doi.org/10.1016/j.jallcom.2017.02.266)

Reference: JALCOM 40994

To appear in: *Journal of Alloys and Compounds*

Received Date: 12 December 2016

Revised Date: 20 February 2017

Accepted Date: 26 February 2017

Please cite this article as: Y. Liu, Y. Wang, Z. You, J. Li, Z. Zhu, C. Tu, Growth, structure and spectroscopic properties of melilite Er: CaLaGa<sub>3</sub>O<sub>7</sub> crystal for use in mid-infrared laser, *Journal of Alloys and Compounds* (2017), doi: 10.1016/j.jallcom.2017.02.266.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

# Growth, structure and spectroscopic properties of melilite Er: CaLaGa<sub>3</sub>O<sub>7</sub> crystal for use in mid-infrared laser

Yunyun Liu<sup>a, b</sup>, Yan Wang<sup>a</sup>, Zhenyu You<sup>a</sup>, Jianfu Li<sup>a</sup>, Zhaojie Zhu<sup>a</sup>, and Chaoyang Tu<sup>a, \*</sup>

<sup>a</sup> Key Laboratory of Optoelectronic Materials Chemistry and Physics, Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences, Fuzhou City, Fujian Province, 350002 P. R. China

<sup>b</sup> University of Chinese Academy of Sciences, Beijing, 100039 P. R. China

\*E-mail: tcy@fjirsm.ac.cn

## Abstract

Single crystals of pure and Er<sup>3+</sup> doped CaLaGa<sub>3</sub>O<sub>7</sub> were firstly grown by the Czochralski technology. The structure of CaLaGa<sub>3</sub>O<sub>7</sub> was investigated. The electronic structures of CaLaGa<sub>3</sub>O<sub>7</sub> crystal were performed by using first-principles calculations based on density functional theory (DFT) methods. Its band structure and density of states were presented. The polarized absorption, emission spectra including up-conversion, near-infrared and mid-infrared fluorescence spectra, as well as the fluorescence decay curves of Er: CaLaGa<sub>3</sub>O<sub>7</sub> crystal were measured at room temperature. Detailed spectroscopic analyses of Er: CaLaGa<sub>3</sub>O<sub>7</sub> were carried out. Based on the Judd–Ofelt theory and the polarized absorption spectra, the spontaneous transition probabilities, the fluorescent branching ratios and the radiative lifetimes were calculated. The energy transfer mechanism in Er: CaLaGa<sub>3</sub>O<sub>7</sub> crystal was also studied in this work. It concludes that Er: CaLaGa<sub>3</sub>O<sub>7</sub> crystal can act as a promising candidate for mid-infrared lasers.

**Keywords:** Er<sup>3+</sup>: CaLaGa<sub>3</sub>O<sub>7</sub> crystal, First-principles calculations, Spectroscopic properties, Mid-infrared laser

## 1. Introduction

In recent years, novel mid-infrared (MIR) solid lasers at the wavelength of 2.7~3 μm have drawn much attention for enormous applications in medicine, detection and remote sensors etc. [1–4]. This is primarily due to the strong absorption by water around this

Download English Version:

<https://daneshyari.com/en/article/5461226>

Download Persian Version:

<https://daneshyari.com/article/5461226>

[Daneshyari.com](https://daneshyari.com)