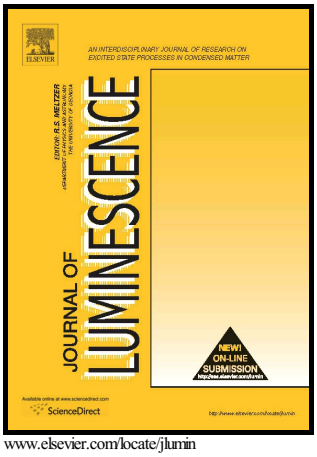

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PII: S0022-2313(16)31519-8
DOI: http://dx.doi.org/10.1016/j.jlumin.2017.03.014
Reference: LUMIN14595

To appear in: *Journal of Luminescence*

Received date: 15 December 2016
Revised date: 9 February 2017
Accepted date: 10 March 2017

Cite this article as: M. Khodasevich, Y. Varaksa, G. Sinitsyn, V. Aseev, M. Demesh and A. Yasukevich, Determining the Stark structure of Yb^{3+} energy levels in $Y_3Al_5O_{12}$ and CaF_2 using principal component analysis of temperature dependences of fluorescence spectra, *Journal of Luminescence* http://dx.doi.org/10.1016/j.jlumin.2017.03.014

Determining the Stark structure of Yb^{3+} energy levels in $Y_3Al_5O_{12}$ and CaF_2 using principal component analysis of temperature dependences of fluorescence spectra

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Abstract

Principal component analysis of temperature dependences of fluorescence spectra of Yb^{3+}:$Y_3Al_5O_{12}$ and Yb^{3+}:CaF_2 is used for determining the Stark structure of Yb^{3+} energy levels. The results obtained are in a good agreement with reference data determined by the conventional methods of absorption and time-resolved fluorescence spectroscopy at low temperatures.

Keywords: principal component analysis; Stark structure; ytterbium; fluorescence.

1. Introduction

The Stark splitting of laser levels has a significant impact on the shape and width of a laser generation and amplification spectrum. Therefore one of the main objectives of spectroscopic investigations of laser active media is the determination of the scheme and the Stark structure of the activator ions multiplets [1]. This problem is solved generally using the conventional methods of absorption and fluorescence spectroscopy at low temperatures (see, for example, [2, 3]). Earlier [4] we proposed a method for determining the Stark structure of the activator ions multiplets by principal component analysis (PCA) [5] applied to a set of the fluorescence spectra at temperatures above the room one. The energy level $^4S_{3/2}$ of erbium ion in lead fluoride glass ceramics has been considered [4]. In this paper we present the results of applying the proposed method to the ytterbium ion in Yb^{3+}:$Y_3Al_5O_{12}$ and Yb^{3+}:CaF_2.

[1]PCA - principal component analysis