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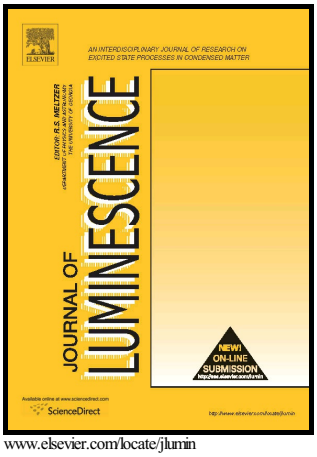

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Temperature and exposure time-dependent scintillation of Eu(III) polyoxometalate under X-ray excitation

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Abstract

Sodium decatungstoeuropate, $Na_9[Eu(W_5O_{18})_2].14H_2O$, is a promising material to convert X-ray into visible light. In this work, temperature and exposure time-dependent scintillation of the $Na_9[Eu(W_5O_{18})_2].14H_2O$ sample under X-ray excitation were evaluated. Light emission intensity decreases along with X-ray exposure time, probably due to electronic defects at $(W_5O_{18})^{6-}$ groups, leading to a lower efficiency of the LMCT (O→W) process, which is determinant in the scintillation mechanism of this material. After X-ray exposition, there is a partial recovery of the initial emission intensity, indicating that defects created are reversible. With temperature increasing, changes in the emission spectra evidence the decreasing of the local symmetry around the Eu^{3+} ions, caused by reticular vibration and dehydration process. The luminescence intensity dependence with temperature suggests the possibility to use this material as molecular thermometer in two different temperatures ranges.

Keywords: Europium; Polyoxometalate; Scintillation; XEOL.

1. Introduction

Scintillators are materials that can convert ionizing radiations (like X-rays) into visible light [1]. Due to this property, these materials are used in ionizing radiations detection and are applied in high-energy physics, dosimetry and medical imaging technologies [2-4]. Despite of impressive advances in the technology of direct detection, the search for new lanthanide-based scintillators materials with high efficiency and for new conformations of these materials is still the focus of research in this area [5-7].

In this context, lanthanide ions-based compounds are promising scintillator materials, due to the singular luminescent properties of these ions [8]. Polyoxometalates containing lanthanide ions (LnPOM) have electrical, magnetic and optical properties with large technological interest [9-11]. Besides, LnPOM can be prepared from low cost synthetic routes and molded into different conformations [10, 12-14].

Among LnPOM materials, sodium decatungstoeuropate, $Na_9[Eu(W_5O_{18})_2].14H_2O$, presents intense red emission with color purity, high luminescence quantum efficiency under ultraviolet (UV) excitation and can be prepared at different conformations [15]. Moreover, europium and tungsten elements have high X-ray mass attenuation coefficients, indicating that this material present high X-ray absorption. The synthesis of this compound dates back almost five decades [16] and since then, there have been no studies about its luminescence under X-ray excitation and about the temperature influence on its luminescent properties.

The study of the luminescent properties as a function of temperature and X-ray exposure time is important to evaluate the possibility of application of the material in scintillation devices. In this work, we discuss the temperature and exposure time-dependent scintillation of the $Na_9[Eu(W_5O_{18})_2].14H_2O$ under X-ray excitation.