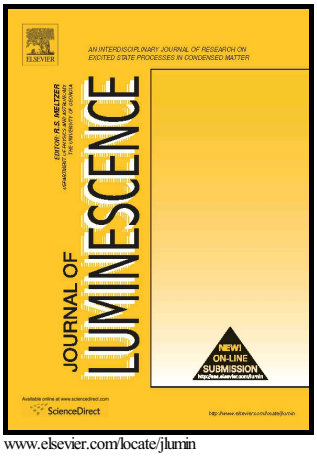

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Charge trapping processes and energy transfer studied in lead molybdate by EPR and TSL

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Abstract

Charge trapping and energy transfer processes are investigated in $PbMoO_4$ single crystals by electron paramagnetic resonance (EPR) and wavelength-resolved thermally stimulated luminescence (TSL) in a correlated manner. New signals produced by two differently perturbed Mo^{5+} centers (Mo2 and Mo3) were observed in EPR spectra measured in the crystals after 420 nm light irradiation. Two sets of spin-Hamiltonian parameters, **g** tensor and the $^{95,97}Mo$, ^{207}Pb (super) hyperfine tensors, have been determined and analyzed in terms of crystal field and LCAO-MO theories. A significant overlap of the Mo $5d^1$ and *6s6p* ligand Pb orbitals was deduced for the Mo3 whereas the Mo2 center seemed to be not or very slightly affected by the lead orbitals. The obtained TSL results allowed to suppose the existence of at least six glow peaks produced by the de-trapping of charge carrier traps either of intrinsic nature or somehow stabilized by nearby accidental impurities. The peaks having maxima at 51 K, 79 K, and 89 K, in particular, were attributed to the Mo2 and Mo3 centers thermal destruction due to the observed correspondence between the kinetic parameters (trap depths and frequency factors) determined separately for the glow peaks and the EPR intensity thermal decay curves of these centers. The Mo2 EPR decay curve is rather complex experiencing two-step trend probably due to trapped electron recombination with some holes released below 60 K. It was further confirmed by the TSL emission maximum relatively large red shift (~100 nm) compared to the much smaller offset measured in radioluminescence. This phenomenon, observed also in samples obtained from extra-pure starting materials, was explained by three-component origin of the spectra, each having
its own thermal fading rate. One of them ceased to exist above 60 K. The discussion of the obtained results is provided in comparison with other representatives of the scheelite tungstate and molybdate-based single crystals.

Keywords: EPR, wavelength resolved TSL, radioluminescence, electron trap, lead molybdate

1. Introduction

Scheelite-type lead molybdate ($PbMoO_4$), $I4_1/a$ space group [1], is extensively implemented in acousto-optics [2] and optoelectronics [3]. It exhibits also photocatalytic properties as it has been reported relatively recently [4,5].