

Eu³⁺ luminescence from different sites in a scheelite-type cadmium molybdate red phosphor with vacancies.

Autorzy

Małgorzata Guzik

Elżbieta Tomaszewicz

Yannick Guyot

Janina Legendziewicz

Georges Boulon

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Artykuł

Eu³⁺-doped scheelite-type cadmium molybdate with the chemical formula Cd_{1-3x}Eu_{2x□_x}MoO₄ (vacancy is denoted by □) was investigated as a red-emitting conversion phosphor for white light emitting diodes (WLEDs) by taking advantage of the Eu³⁺ spectroscopic probe to analyze in detail the structural properties as a continuation of our previous analysis on both, Cd_{1-3x}Nd_{2x□_x}MoO₄ and Cd_{1-3x}Yb_{2x□_x}MoO₄. A series of microcrystalline samples were synthesized using a high-temperature solid state reaction. X-ray diffraction patterns indicate that the samples show only one phase and crystallize in the tetragonal scheelite-type structure (space group *I*4₁/*a* with point symmetry *S*₄), when the concentration of Eu³⁺ ions is in the range from 0.05 mol% to 66.67 mol% with respect to Cd²⁺ ions. Substitution of divalent Cd²⁺ by trivalent Eu³⁺ cations leads to the formation of cationic vacancies in the framework due to the charge compensation: 3Cd²⁺ → 2Eu³⁺ + □ vacancy. The □ vacancy concentration dependence brings some originality to this research program in optical materials. High-resolution photoluminescence excitation and emission spectra were investigated. Time-resolved laser spectroscopy performed at room temperature and at 77 K allowed the separation of lines corresponding to transitions from the ⁵D₁ and ⁵D₀ levels, respectively, and to define the contributions of the individual emission lines in the steady state spectrum. Low temperature fluorescence spectra obtained by applying laser site-selective excitation confirmed the presence of multisite characteristics of Eu³⁺ ions in this host lattice, similar to that found for Nd³⁺ and Yb³⁺ dopants. Three types of Eu³⁺ sites have been identified. These phosphors are efficiently excited by UV light, and exhibit a very strong red luminescence corresponding mainly to the electric dipole ⁵D₀ → ⁷F₂ transition at 616 nm, and thus they are considered as promising phosphors for WLEDs. Concentration quenching of Eu³⁺ luminescence as well as the optimum doping of optically active ions were investigated.

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