# Fine structure in high resolution $4f^7$-$4f^6$5d excitation and emission spectra of X-ray induced $Eu^{2+}$ centers in $LuPO_4$:Eu sintered ceramics.

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Streszczenie

X-ray induced effects in $LuPO_4:Eu^{3+}$ sintered thermoluminescent material were investigated by absorption and photoluminescence measurements between 20 and 300K. Evidence for $Eu^{3+} \rightarrow Eu^{2+}$ conversion upon exposure to X-rays was obtained as narrow band blue $Eu^{2+}$ photoluminescence was observed. The low temperature luminescence of $Eu^{2+}$ ions in X-rayed $LuPO_4$:Eu ceramics showed a unique fine structure with a sharp zero-phonon line at 425.8nm and well-resolved vibronic structure. Excitation spectra of the $Eu^{2+}$ luminescence revealed a rich structure in which individual $4f^7 \rightarrow 4f^6(^7F_J)5d^1$ zero-phonon lines accompanied by vibronic transitions were identified. A detailed analysis allowed an accurate calculation of the $Eu^{3+}$-like $4f^6(^7F_J)$ core levels in the $4f^6 5d^1$ excited configuration. The $4f^6$ core splitting is different from that of the $^7F_J$ states for $Eu^{3+}$ in $LuPO_4$, providing evidence for the role of $4f^6$–5d interaction on the splitting of the $4f^6$ configuration. The unique luminescence of $Eu^{2+}$ with a small Stokes shift and well-determined energies of $4f^6(^7F_J)5d^1$ excited states make $LuPO_4$:Eu a model system for testing theoretical models which are presently developed to calculate and predict the energy level structure and Stokes shift of $4f^n$–$4f^{n-1}5d^1$ transitions of lanthanides.

Słowa kluczowe

LuPO4, Eu2+ luminescence, Zero-phonon line, 4f6 5d excited state, High resolution spectroscopy

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