Investigations on the electric-dipole allowed $4f^25d \rightarrow 4f^3$ broadband emission of Nd^{3+}-doped $20Al(PO_3)_3$-80LiF glass for potential VUV scintillator application.

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Streszczenie

We report the absorption and emission properties of neodymium (Nd^{3+})-doped APLF glasses [$20Al(PO_3)_3$-80LiF + x NdF_3, x = 0.5–2.0 mol%] as potential vacuum ultraviolet (VUV) scintillator materials due to their interconfigurational $4f^25d$ transitions which have not yet been investigated. The Nd^{3+}-doped APLF glasses exhibit absorption and emission peaks from the VUV to the near-infrared (NIR) regions which correspond to the different interconfigurational $4f^25d$ and intraconfigurational $4f^3$ transitions of Nd^{3+} ions. Detailed analysis of the absorption and emission spectra reveals that the Nd^{3+}-doped glass has a disordered structure and low symmetry, as expected from amorphous materials. However, the most important feature of these glasses is their electric-dipole allowed $4f^25d \rightarrow 4f^3$ ($^4I_{9/2}$) broadband emissions, between two configurations of opposite parity, around 187 nm (VUV) whose ~ 5.0 ns decay times are faster than known Nd^{3+}-doped scintillators. At room temperature (RT), the absorption edge located around 192 nm overlaps with this VUV emission indicating that self-absorption primarily limits the emission intensity. This overlap could potentially be minimized by working at low temperatures and doping with higher (>2.0 mol%) concentrations. Despite the presence of self-absorption, the fast emission decay times from the $4f^25d$ excited state make the Nd^{3+}-doped APLF glasses promising new VUV scintillator materials for high-counting-rate fast neutron detection.

Słowa kluczowe

Aluminum lithium fluorophosphate glass, Nd3+ doping, Spectroscopy, 4f25d and 4f3 configurations, VUV scintillator, Neutron detection