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Structural incorporation of Cm^{3+} and Pu^{3+} in phosphate ceramics with monazite structure.

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Phosphate ceramics with monazite structure are considered as potential waste forms for the conditioning of specific nuclear waste streams (e.g. minor actinides and plutonium) due to their outstanding properties. In this study, the incorporation of actinides (Cm^{3+} and Pu^{3+}) into the monazite structure has been investigated combining X-ray diffraction (XRD) as well as X-ray absorption- (XAS) and time-resolved laser fluorescence spectroscopy (TRLFS).

The results demonstrate the incorporation of the actinides on defined lanthanide lattice sites in the monazite ceramics. From TRLFS measurements of Cm-doped (50 ppm) $(\text{La,Gd})\text{PO}_4$ solid solutions, a decrease of short-range order for the solid solution compositions was observed in comparison to the end-members. Additionally, XAS investigations on pure-phase $\text{La}_{1-x}\text{Pu}_x\text{PO}_4$ ($x = 0.01 - 0.15$) solid solutions verify the incorporation of plutonium in the +III oxidation state in the monazites. The results provide a refined structural insight into mechanisms of actinide incorporation into monazite ceramics and solid solution formation.

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