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## Monazite as promising candidates for nuclear waste management: Structural characterization by X-ray Absorption Spectroscopy

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Minor actinides such as Np, Am, and Cm contribute a major part of the heat load and radiotoxicity of spent nuclear fuel. Their separation and incorporation into stable ceramic phases may provide a route for their safe storage in deep-geological repositories or for their transmutation to short-lived nuclides. Natural monazites, early-lanthanide phosphate minerals of old age, contain up to 27 wt %  $\text{UO}_2 + \text{ThO}_2$ , demonstrating thereby a high incorporation capacity, high chemical durability and high resistance to radiation damage. Therefore, monazite-type ceramics are promising candidates for the long-term incorporation of minor actinides. The aim of this work is to reveal the structural changes of  $\text{LaPO}_4$  monazite induced by the incorporation of europium, an analogue for trivalent actinides.  $\text{La}_{1-x}\text{Eu}_x\text{PO}_4$  monazite solid-solutions with  $x$  from 0.2 to 1.0 were synthesized and characterized by Eu L3-edge and La L1-edge, extended X-ray absorption fine-structure (EXAFS) spectroscopy at the Rossendorf Beamline (ESRF, France). Structural refinement of X-ray diffraction data showed a Vegard-like behavior of metal-oxygen and metal-metal distances, i.e. a linear decrease of these distances with increasing Eu content. In contrast, EXAFS analysis revealed that only the La-O distances in the first coordination shell and the first metal-metal distances decrease according to Vegard's law, while the Eu-O local coordination remains unchanged. These new EXAFS results provide important insight into the structural basis of the ideality and therefore stability of monazite solid-solutions; they will be used in the future to develop the thermodynamic constants needed for long-term stability predictions.

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