Rare-Earth solubility limits in simplified borosilicate glass

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Abstract

The French nuclear waste management strategy is directed towards reprocessing of spent nuclear UOX fuel and conditioning of high level wastes (HLW) in borosilicate glass. In the future, the treatment of different irradiated fuels (PWR, MTR, sodium-cooled fast reactors fuels...) will generate new HLW compositions, especially composed by higher rare earth (RE) and minor actinides amounts and the knowledge of their solubility in the glass is essential to promote this evolution.
Previous studies have shown that a strong RE percentage can lead to the crystallization of apatite-like phases, Ca2RE8(SiO4)6O2, in the melt or during the cooling process happening within the container.
In this study, the solubility of those elements (particularly La, Ce, Pr, Nd and Gd) was explored in the SiO2-B2O3-Na2O-CaO-Al2O3-RE2O3 system to better understand the interactions between them afterwards, with a focus on Gd interaction with the other RE, and their role in the formation of apatite structures.

Keywords: nuclear waste, glass, rare earth, solubility

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