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Determination of Ce^{3+} Content in $MHfO_3$:Ce (M=Ba, Sr) Scintillators by Ce L and K Edge XANES

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Introduction: Research on solid state scintillating materials for high-energy applications has been on going for the last few decades. However, only a few classes of new materials have been found. The hafnate perovskites $MHfO_3$ (M=Ba, Sr, Ca) represent a new class of materials with large potential impact in high energy nuclear medical applications. They are Ce^{3+} activated, with a parity allowed 5d -> 4f transition that is intense in several host lattices, while simultaneously allowing fast decay constants (25-40ns). The luminescent properties of these materials are dependent not only on the level of Ce^{3+}, but also on the type of co-dopant in the structure.

Results: $(M_{1-x}Ce_x)HfO_3$ prepared under reducing atmosphere and at different temperatures were studied by XANES to determine the relative amount of Ce^{3+}/Ce^{4+} in the structure. For Sr-containing compounds, the measurements were preformed at L edge, but for Ba- containing compounds, the measurements were at K edge because the L edges for Ba and Ce are too close to be separated. The results show that in $(Ba,Ce)HfO_3$, even at high temperatures and reducing atmosphere, the relative amount of Ce^{3+} reaches only 80%, while for $(Sr,Ce)HfO_3$, the relative amount of Ce^{3+} is nearly 100% even at low temperatures. The SrHfO3 host lattice seems to be the best choice to maximize both efficiency and processing in this class of materials.

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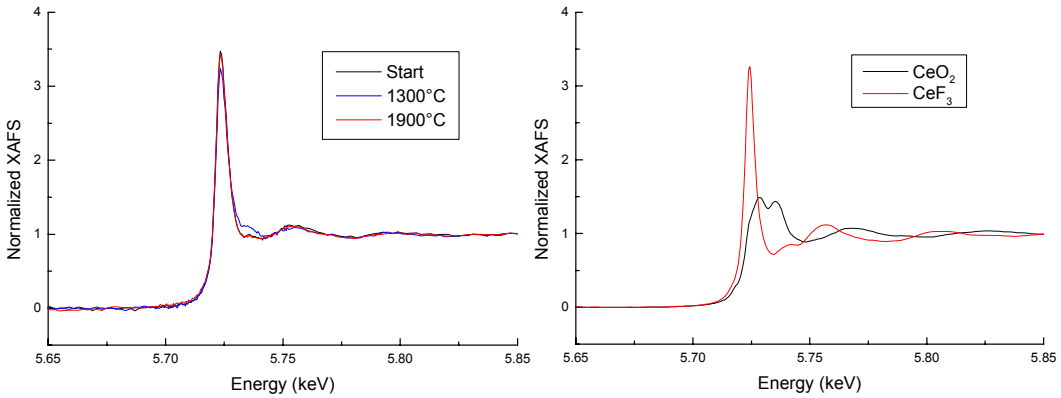

Figure 1 Left - XANES spectra of $(Sr,Ce)HfO_3$ “as prepared” and at 1300°C and 1900°C
Right - XANES spectra of the standards Ce^{3+} (CeF_3), and Ce^{4+} (CeO_2).