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Thermal and elastic properties of CexTh1-xO2 mixed oxides: a self-consistent thermodynamic approach

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Nuclear fuel based on mixture of thorium dioxide ThO2 with uranium or plutonium is perspective for many types of breeder reactors, e.g. liquid metal cooled fast breeder reactors (LMFBR), advanced heavy water reactors (AHWRs), gas cooled reactors (HTGR), etc. [1]. Effective and safe usage of these fuels requires information on its thermal and mechanical properties. In the case of PuxTh1-xO the available experimental data on these properties is very scarce, probably due to high radioactivity of plutonium. Therefore, in place of PuO2, its surrogate CeO2 is often used since the physicochemical properties of these two compounds are similar. In the present study we investigate temperature dependencies of the heat capacity, volumetric coefficient of thermal expansion, bulk modulus and thermal conductivity of CexTh1-xO2 systems by means of a self-consistent thermodynamic approach. This approach incorporates the impact of anharmonicity of both the acoustical and optical phonon modes.
[1] International Atomic Energy Agency, Thorium Fuel Cycle-potential Benefits
and Challenges, IAEA-TECDOC-1450, IAEA, Vienna, 2005.

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