Thermodynamic characterization of the Molten Salt Reactor fuel

Abstract:
The Molten Salt Reactor (MSR) has been selected as one of the Generation IV nuclear systems. The very unique feature of this reactor concept is the liquid nature of the fuel which offers numerous advantages concerning the reactor safety. Nowadays, the research in Europe is focused on an innovative concept, the MSFR (Molten Salt Fast Reactor), that combines the generic assets of molten salt as liquid fuel with those related to fast neutron reactors and the thorium fuel cycle. For the design and safety assessment of the MSFR concept, it is extremely important to have a thorough knowledge of the physico-chemical properties of fluorides salts, which is the class of materials that is the best suited for nuclear applications. Potential chemical systems have been critically reviewed and an extensive thermodynamic database describing the most relevant systems has been created at the Institute for Transuranium Elements of the Joint Research Centre (JRC). Thermochemical equilibrium calculations are a very important tool that allows the evaluation of the performance of several salt mixtures predicting their properties and thus the optimization of the fuel composition. The work combines the experimental determination of different salt properties with the modelling of the thermodynamic functions, using the Calphad method. An overview of the experimental work and the thermodynamic assessments will be given in this paper and different fuel options for the MSFR will be discussed.

URI:
Authors:
CAPELLI Elisa
BENES Ondrej
KONINGS Rudy
Publication Year:
2015
Science Areas:
Nuclear safety and security [1]

Keywords:
actinide [2]
nuclear [3]
reactor [4]
reference data [5]
research [6]