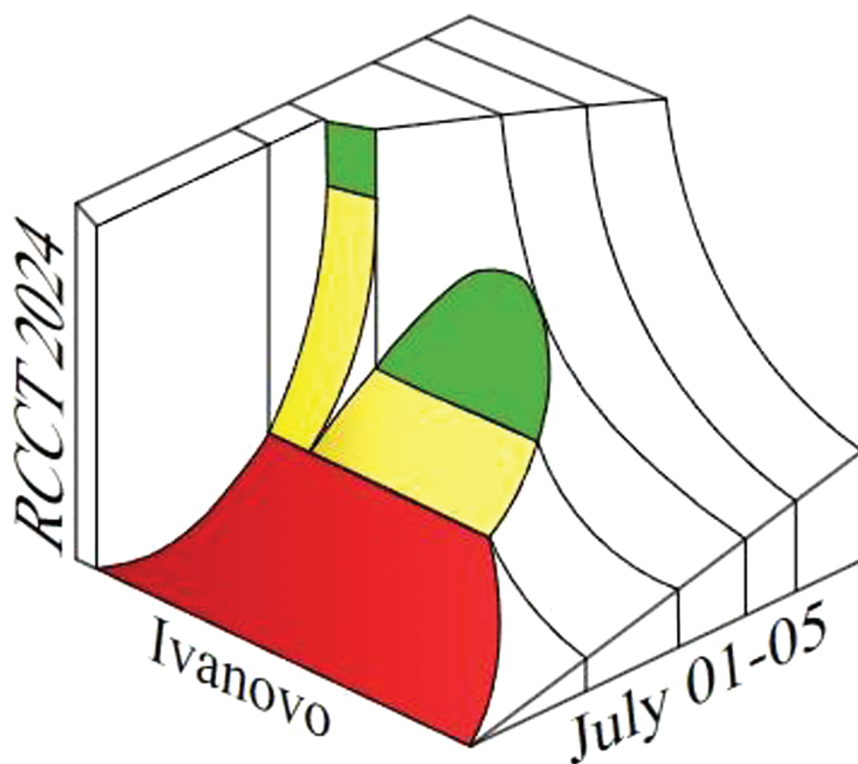


XXIV International Conference on Chemical Thermodynamics in Russia

**July 1-5, 2024
Ivanovo, Russia**

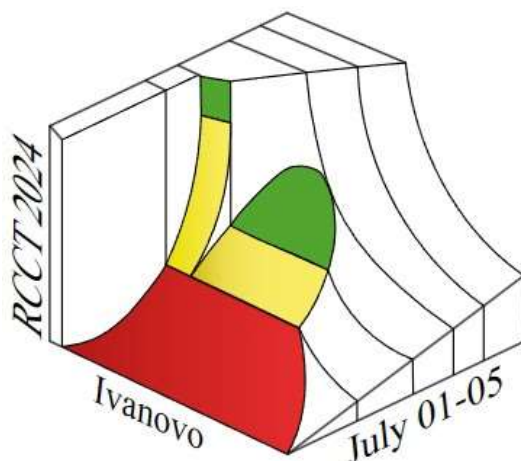


RCCT-2024

BOOK OF ABSTRACTS

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G.A. Krestov Institute of Solution Chemistry of the Russian Academy of Sciences

Ivanovo State University of Chemistry and Technology

**Kurnakov Institute of General and Inorganic Chemistry of the Russian Academy of
Sciences**

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THERMODYNAMIC PROPERTIES IN THE Cs₂O-SrO-Al₂O₃-SiO₂ SYSTEM STUDIED BY THE KNUDSEN EFFUSION MASS SPECTROMETRIC METHOD

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Vaporization of cesium and strontium compounds from the core material during severe accidents at nuclear power stations may lead to hazardous radioactive pollution of the environment [1]. For better understanding of high temperature behavior of multicomponent core material, the model Cs₂O-SrO-Al₂O₃-SiO₂ system was considered in the present study since alumino-silicate matrices were mentioned as potential candidates for reliable waste forms for cesium and strontium [2].

In the present study, the vaporization processes and thermodynamic properties of the Cs₂O-SrO-Al₂O₃-SiO₂ system were studied by the Knudsen effusion mass spectrometric (KEMS) method [3]. The samples in the system under consideration were synthesized by the sol-gel method based on Cs₂CO₃, SrCO₃, Al(NO₃)₃•9H₂O, and tetraethoxysilane (C₂H₅O)₄Si as initial components involving nitric acid with the maximum annealing temperature of 1073 K for 622 hours. The samples obtained were characterized by X-ray phase analysis, electron probe microanalysis, differential thermal analysis, and X-ray fluorescence analysis. Identification of the structure as well as phase and chemical compositions of the samples of the Cs₂O-SrO-Al₂O₃-SiO₂ system allowed the KEMS study to be carried out using an MS-1301 mass spectrometer at an ionizing voltage of 30 V from a single tungsten effusion cell.

The vaporization of the samples in the Cs₂O-SrO-Al₂O₃-SiO₂ system was observed at temperatures above 900 K. The main vapor species over the samples were Cs and O₂, leading to selective removal of Cs₂O from the samples. The vaporization of the samples without Cs₂O was found at temperatures above 1800 K, with the main vapor species being Sr, SiO, and O₂. The temperature dependences of the partial pressures of the vapor species over the samples under study were obtained by the KEMS method. These data enabled the partial vaporization enthalpies of Cs₂O as well as mass losses of the samples to be determined. The data obtained were also used to derive the temperature dependences of the component activities and calculate partial molar enthalpies of mixing in the Cs₂O-SrO-Al₂O₃-SiO₂ system. Negative deviations from the ideal behavior were established in the system under study at the temperatures 1000, 1100, and 1200 K. It was shown that introduction of SrO in the Cs₂O-Al₂O₃-SiO₂ system led to decrease in the Cs₂O activity coefficients. As for the influence of Al₂O₃ and SiO₂, the minimum values of the Cs₂O activity coefficients were observed in the samples with the equimolar content of Al₂O₃ and SiO₂, showing the concentration ranges with the optimal thermal stability.

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