

**THERMODYNAMICS OF Ca–Al-INCLUSION'S HIGH-TEMPERATURE MINERALS.**

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Formation of the Ca–Al-inclusions (CAI) in chondrite presents a certain interest as the CAI are the earliest objects of the Solar system with unusual isotopic characteristics. Of great importance in the history of meteoritics and in the CAI studies is Grossman's physico-chemical model of the condensation origin of the CAI substance [1]. According to Grossman's model the CAI substance was formed in the course of consecutive condensation at cooling of the Solar composition gas that can be thermodynamically described by using data on the total vapor pressure over the minerals that form the CAI. The basic CAI minerals can be divided into 3 groups: poorly volatile (or refractory) – corundum, hibonite, grossite, dmitryivanovite and perovskite; medium volatile – magnesium spinel, gehlenite, forsterite and enstatite; highly volatile – diopside, akermanite, anorthite and grossular [2]. Observable differences in total CAI compositions can be related to the forming minerals' volatilities.

The purpose of this work was to consider the thermodynamic properties – activities of oxides, temperature dependences of partial pressures of vapor species and the gas phase composition over corundum, hibonite, grossite and dmitryivanovite (as the most refractory CAI minerals) at 1600–2500 K to clarify the temperature effect on the CAI substance formation. The thermodynamic information was obtained by calculation within the framework of a model based on the theory of ideal associated solutions [3]. The initial data for the calculation were the experimental results obtained by the Knudsen effusion mass spectrometric method [4, 5].

The thermodynamic data obtained on corundum, hibonite, grossite and dmitryivanovite show that the temperature dependences of the total vapor pressure over these minerals are close (within an order of magnitude). Comparison of the total vapor pressure values over the CAI refractory minerals makes it possible to estimate the condensation sequence of the minerals under consideration depending on the temperature.

At the same time the temperature dependences of the vapor composition over these minerals differ considerably. This is conditioned by changes in the oxide's activity values in the CaO–Al<sub>2</sub>O<sub>3</sub> system at transition from the crystalline to the liquid state.

**References:** [1] Grossman L. 1972. *Geochim. Cosmochim. Acta* 36:597–619. [2] Shornikov S. I. 2014. *Experiment in Geosciences* 20:75–76. [3] Shornikov S. I. 2004. *Herald Earth Sci. Dept. RAS* 21:189–192. [4] Shornikov S. I. et al. 1997. *Russ. J. Phys. Chem.* 71:19–22. [5] Shornikov S. I. et al. 1997. *Russ. J. Phys. Chem.* 71:23–27.

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