Equation of state for the liquid phase of scandium based upon a simple thermodynamic model

Boyarskikh K.A.[1,@] **and Khishchenko K.V.**[1]

[1] Joint Institute for High Temperatures of the Russian Academy of Sciences, Izhorskaya 13 Bldg 2, Moscow, 125412, Russia

[@] shagom55@gmail.com

The solution of many problems in modern science is associated with the need to conduct hydrodynamic modeling of physical processes in matter, which requires knowledge of the properties of the system under consideration. Information about the thermodynamic characteristics of a material is usually specified in the form of an equation of state, which acts as a closure relation for a system of equations expressing the laws of conservation of mass, energy, and momentum. Scandium stands out among the substances used to solve applied problems in physics and power engineering. It is necessary to know the properties of this rare earth metal over a wide range of pressures and temperatures. In this work, an equation of state for scandium in the liquid phase is proposed based on a simple semiempirical model. Functional dependences of specific free energy on specific volume and absolute temperature are used. The parameters of the model dependences were determined based upon the condition of best describing the experimental data. Using the resulting equation of state, the characteristics of scandium under shock loading and thermal expansion were calculated. Agreement between the calculated results and experimental data is achieved.

The equation of state for the liquid phase of scandium proposed in this work can be successfully integrated into software packages for mathematical modeling of physical processes at high pressures and temperatures.

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