CALCULATION OF THERMOPHYSICAL PROPERTIES OF CRYPTON AND XENON BASED ON FRACTAL EQUATION OF STATE

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The actuality of the study of new materials and substances (determination of thermophysical properties) in connection with the development of new technologies in industry, resulted in appearance of a new state equations and development of substance thermophysical properties calculation methods, including methods with the application of the integro-differentiation of fractional order.

The need of computational data for the thermophysical properties of substances at high temperatures and pressures close to the extremes arises in connection with the complexity of the experimental study of such states.

Transition from the ordinary derivatives to derivatives of fractional order is connected with the principles of the physics of many-particle systems and realized on the basis of generalization of thermodynamics. From the derived "fractal" state equation:
$P = \rho T \frac{R}{M}\left\{1+\rho B+(1-\alpha)\left[\ln\left(\frac{eM}{\rho N_A}\left[\frac{mkT}{2\pi\hbar}\right]^{3/2}\right)+\psi(1)-\psi(2-\alpha)-\rho B\right]\right\}$
we can define the rate of the fractional order derivative α and further calculate thermodynamic properties, using the obtained analytical expressions for entropy and isochoric heat capacity [1]. The transition to classical thermodynamics is obtained in the particular case when the rate of the fractional order derivative is equal to unity.

On the basis of the "fractal" state equation, with account of second virial coefficient B, the thermophysical properties of krypton Kr and xenon Xe: entropy S and isochoric heat capacity C_V have been calculated. Obtained results are in good agreement with the reference data. Deviation for the entropy is ~ 0.03 %, and for the heat capacity is ~ 2.4 %, which indicates the promise of the proposed method.

This paper has been supported by Russian Foundation for Basic Research (Grant No. 16-08-00067a).

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1. Magomedov R.A., et al.//JTAC, 2018. P. 1-6. doi:10.1007/s10973-018-7024-2