Ob cesium vapor near to the line of condensation is the plasma?

O.D.Zakharova, N.P.Petkoglo, A.M.Semenov
The Moscow Power Engineering Institute (Technical University)

The density of cesium is measured in method of attenuation of γ – radiations [1,2] in very wide range of temperatures and the pressure, include conditions pair, liquids and a supercritical fluid. The analysis of the data received for subcritical and nearcritical area has shown, that compressibility $z = p/(\rho RT)$ (p — pressure, ρ — density, R — individual gas constant) at temperatures 1700 – 2200 K ($T_c \approx 2040 \pm 20$ K [1]) and pressure from 2 up to 6 МПа ($p_c \approx 11.8 \pm 1.0$ MPa [1]) take on values from 1 up to 1.3. Thus the ratio of pressure to saturated vapor pressure (and to critical pressure at supercritical temperatures) is in a bound of 0.3 – 0.5, i.e. vapor is rather rare.

As is known, in considered area of state parameters the cesium atoms are vigorously attract one another, that, in particular, results in formation of appreciable quantity of Cs_2 dimers. Therefore the gas compressibility "in norm" should be less than 1. It is possible to explain considered effect only presence of light particles which raise pressure, but do not bring the contribution to density — i.e. the electrons. Hence, the data [1,2] represent to cesium vapor appreciable ionization. This conclusion of authors [1,2], proved by theoretical estimations, has been actively second by other experts in the field of nonideal plasma, which demonstrated, that cesium vapor abnormal ionization is caused by multinuclear charged clusters formation.

The authors of this communication, using little–constants semi empirical equation of state for calculation of thermodynamic properties of alkali metal vapor, have fulfill the joint statistical analysis of available experimental data about density cesium vapor. It has been established, that results of the majority of measurements well (within the limits of 1-3%) will be coordinated with each other, while their divergences with the data [1,2] in considered area of temperatures and pressure are unacceptable great (20-30%). The reference book data [4], which basic on the Moskow Aviation Institute (N.B. Vargaftik) and US Naval Research Laboratory are put (C.T. Ewing) measurements results, show quite "normal" behaviour of cesium vapor at the same pressure and temperatures where the data [1,2] specify anomaly: z i is in a bound of 0,85 – 0,95. It is follows from here, that the data [1,2] are erroneous, at least, in discussed state parameters area.

Authors were convinced also, what it is impossible to receive in theoretical calculation such degree of ionization pair cesium, to reproduce the data [1,2]. For an estimation, the calculation of compressibility on the above mentioned equation of state has been added with the account of the contribution of first ionization of atoms. If to use in calculation the "true" value of cesium atom ionization energy, the contribution of ionization, naturally, raises the compressibility on completely insignificant size 10^{-5}-10^{-6}. But even if to use instead of energy of ionization the electronic work function of solid cesium, lower which the ionization energy cannot appear at any nonperfection, the compressibility will increase only on 10^{-3} instead of 0.2 – 0.3 that required.

REFERENCES

1. *Korshunov J.S., Senchenkov A.P., Asinovskij E.I., et all.* // High Temperatures. 1970. V. 8. No 6. P. 1288.

2. *Korshunov J.S., Vetchinin S.P., Senchenkov A.P., et all.* // High Temperatures. 1975. V. 13. No 3. P. 517.

3. *Vargaftik N.B., Voljak L.D., Stepanov V.G.* Handbook of Thermodynamic and Transport Properties of Alcali Metals / R.W. Ohse ed. IUPAC chemical data series No. 30. – Oxford, UK: Blackwell Sci. Publ., 1985. P. 641.