CALCULATION OF THE THERMODYNAMIC, OPTIC AND TRANSPORT PROPERTIES OF NON-IDEAL PLASMA OF RARE GASES AND METAL VAPOR USING BASIC CHEMICAL MODELS

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At present, chemical models of plasma became the basic instrument of calculation of thermodynamic functions and composition of plasma. Results of such calculations are used for transport, optic and other plasma properties. Many variants of chemical models using approaches, developed in the theory of fluid, that allowed to calculate an equation of state and ionization balance of fluid at near and supercritical densities, are appeared. Some chemical models predict the existence of unusual phase transitions: plasma, dissociative, etc., and the some are not. A visiting card of any chemical model is the position taken by authors at a choice of: the model of accounting of free charges interaction, a method of limitation of the atom partition function, etc. Different methods of a solution of the mentioned above problems in the literature generate tens variants of chemical model of plasma. Of course, at moderate densities and pressures (up to several tens atmospheres) all models gives similar results. Differences become essential with increase of pressure and density. A number of fundamental problems remain unsolved. First of all is a problem of a self-consistent choice of corrections of free charges interaction and calculation of atom partition function. The establishment of procedure of such agreement is in a basis of the method explicated by authors that obtained a title «the concept of basic chemical models of plasma».

Basic ideas of the new concept are given in suggested report, fundamental relations are presented also.

Unexpected results are obtained for basic chemical models with the partition function in nearest neighbor approximation. Corrections of free charges interaction essentially less corrections, obtained by Debye theory widely used in the literature.

Numerous calculations of an equation of state and Hugoniot adiabats are executed for plasma of hydrogen, caesium and rare gases at pressures up to 100 kbar and temperatures up to 50000 K. Basic chemical models with the partition functions in approximation of the Plank – Larkin and in the nearest neighbor are used. Comparison with experiments showed, that the best agreement with experiments is given by basic chemical model with the partition function in nearest neighbor approximation.

Calculation of the hydrogen plasma absorption coefficient in visible and near ultraviolet region where it is determined by bound-bound and bound-free transition is considered on the basis of the analysis of the bound states density. The rated expressions depending on probability of bound states realization are obtained.

The electrical conductivity of dense plasma of rare gases and aluminum is calculated within the framework of basic chemical models.

The main result is the comparative analysis within the framework of the new uniform method extrapolation properties of several basic chemical models as applied to thermodynamic, optic and transport properties of non-ideal atomic plasma on the basis of comparison with the experiment results.