equation of state and electrical conductivity of plasma fluid of posttransition metals

Khomkin A.L., Shumikhin A.S.

Joint institute for high temperatures of RAS, Moscow, Russia, shum\_ac@mail.ru

In this paper, the generalized model is proposed for the description of thermodynamic and transport properties for post-transition metals (Al, Ga, In, Tl, Pb, Bi), based on the plasma fluid model proposed in [1]. A special feature of the model is the use of solid state characteristics to describe the properties of the fluid (gas state): the cohesive binding energy of atoms and the appearance of an electron jellium – the origin of the band structure. Jellium arises from the tails of the electron density of the ground state of all atoms lying outside the atomic Wigner-Seitz cells. The increase in conductivity of the vapors during the compression is due to the conductivity of the new component – jellium. The concentration of jellium is determined by integrating the Hartree-Fock-Slater wave functions. The concentration of thermal electrons is determined by the Saha formula taking into account all types of correlation. The interaction of free charges is described in the nearest neighbor approximation. The equation of state and transport properties of the post-transition metals plasma fluid are calculated in a wide range of temperatures and densities. The critical point parameters of the vapor-liquid phase transition for Ga, In, Tl, Pb, Bi are calculated. The proposed “3+” model describes a continuous transition from gas-plasma conductivity to metal one.

References

1. Khomkin A.L., Shumikhin A.S., JETP, 2017, 125, 1189.