The formation of metallic hydrogen, predicted in [1], was observed experimentally in [2]. It is also assumed that this state of solid hydrogen is a superconductor at room temperature. As it was shown in [3], atomic metallic hydrogen at zero temperature exists in a metastable state up to normal pressure.

The quantum molecular dynamics method within the density functional theory has been used to calculate the equation of state, pair correlation function, electrical conductivity and density of states of hydrogen in the region of formation of a conducting phase. The results are averaged over the set of equilibrium ion configurations. The VASP plane-wave code is used.

For solid hydrogen a hysteresis of the dependence of pressure on density is observed in the pressure range from 350 GPa to 625 GPa. During compression, the transition of molecular hydrogen with the C2/c symmetry to a conducting atomic state with the C222\textsubscript{1} symmetry through an intermediate conducting molecular phase with Cmca-4 symmetry is observed. The results of calculation of the band structure of the molecular state Cmca-4 point to the semimetalic mechanism of conductivity. The possibility of the existence of conductive atomic solid hydrogen with P2\textsubscript{1}/c symmetry under expansion up to a pressure of 350 GPa is shown.

The conclusion is drawn that the fluid-fluid phase transition in warm dense hydrogen is a plasma phase transition. Thus, the predictions of Norman and Starostin [4], were mainly justified: (a) the phase transition associated with ionization is observed experimentally, (b) the equilibrium and metastable branches of the isotherm strongly overlap in density both for the solid and fluid hydrogen, (c) the critical temperature is about 1000 K, (d) there is a triple point on the melting line.

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