Investigation of electrophysical properties of hydrogen under isentropic compression up to megabars pressure

G.V.Boriskov, A.I.Bykov, M.I.Dolotenko, N.I.Egorov, A.C.Korshunov, Yu.B.Kudasov*, I.V.Makarov, V.D.Selemir, A.V.Filippov

NTCF, RFNC-VNIIEF, Sarov

A high-frequency technique for study of electrophysical properties of substances under pulsed impacts is developed. The fast measuring device with operating frequency of 50 MHz allows determining the dielectric constant and conductivity of a substance under investigation. The measurements in a narrow frequency band make possible an effective suppressing electromagnetic noises arising in pulsed power experiments.

An experiment for investigation of properties of solid hydrogen under isentropic compression up to 3.5 Mbar is performed. Solid hydrogen at 5 K was placed in a cylinder chamber of about 20 cm^3 in volume. The compression of the chamber occurred under an ultrahigh magnetic field of MC-1 generator. The smoothly increasing pulse of the magnetic field allowed to performed the compression isentropically, i.e. in a shock-free regime. The process of the compression was checked by means of pulsed gammagraphy. MHD calculations of the compression dynamics were performed and their results were in a good agreement with the experimental data. The temperature calculated at the pick pressure (3.7 Mbar) was about 200 K.

While the pressure increases the dielectric constant smoothly increases from 1.23 at the standard pressure up to 14 at 2.5 Mbar. At the pressure about 3 Mbar the conductivity of about 0.01 $(Ohm\ m)^{-1}$ appears and rapidly increases. It becomes higher than 1 $(Ohm\ m)^{-1}$ at 3.5 Mbar.