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Physical Transformation of Matter at High Energy Density and Multi-Phase Equation of State VLADIMIR FORTOV, JIHT RAS — The experimental investigation of equations of state, adiabatic compressibility and dc, ac electrical conductivity of hot dense matter shocked and quasiisentropically compressed by reverberating shock waves up to megabar pressure range are presented. HE-driven generators of intense shock waves were used for generation of dense strongly non-ideal plasma with intense interparticle interaction and Fermi-Boltzmann types of statistics. The thermodynamic measurements demonstrate density increase at megabar pressure just in the density range where the electrical measurements have shown five orders of magnitude electrical conductivity increase due to pressure ionization. These thermodynamic experimental data in combination with the electrical conductivity measurements were interpreted as the experimental evidence of a phase transition in strongly non-ideal plasma. The existence of this new phase transition is supported by the ab initio Quantum Monte-Carlo, Density Functional Theory, and Molecular Dynamic computer simulations. Pressure "dielectrization" in shock compressed Li, Na, Ca was also detected. The semi-empirical multi-phase equation of state of materials in a broad region of phase diagram is constructed. The results of 2 D and 3 D computer simulation of high energy density phenomena based on this semi-empirical EOS are presented.

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