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Intense Shock Waves and Strongly Coupled Plasmas

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The report presents the recent results of experimental investigations of equations of state, compositions, thermodynamical and transport properties, electrical conductivity and opacity of strongly coupled plasmas generated by intense shock and rarefaction waves. The experimental methods for generation of high energy densities in matter, drivers for shock waves and fast diagnostic tools are discussed. Application of intense shock waves to solid and porous targets generates nonideal plasmas in megabar-gigabar pressure range. Compression of plasma by a series of reverberating shock waves allows us to decrease irreversible heating effects. To increase the irreversibility effects and to generate high temperature plasma states the experiments on shock compression of porous samples (fine metal powder, aerogels) were performed. The adiabatic expansion of matter initially compressed by intense shocks up to megabars allows investigating the intermediate region between the solid and vapor phase of nonideal plasmas, including the metal-insulator transition phase and the high temperature saturation curve with critical points of metals. The shock-wave-induced non-equilibrium phenomena at fast melting, spallation and adiabatic condensation are analyzed in the framework of the interspinodal decomposition model. The spall strength of single and polycrystal metals at extremely fast deformation produced by fast shock waves is discussed. The “pressure ionization” phenomena in hydrogen, helium, argon, xenon, krypton, neon, iodine, silica, sulfur, fullerenes, and some metals are analyzed on the base of multiple shock compression experiments. For some simple metals (Li, Na, Ca) the effect of “dielectrization” as a result of multiple shock compression are discussed.