Shock-induced elastic, plastic and polymorphic transformations in iron films by picosecond laser pulse

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We present analyses of experimental and numerical studies of laser shock waves initiated by a picosecond pulse in iron. A very high deformation rate is a peculiarity of this research. It is important to understand how the deformation rate affects elastic-plastic and polymorphic transformations. The study of this problem is necessary for the development of a consistent theory of hardening of metals. A series of experiments were performed. Theoretical interpretation of experimental data is developed. Diagnostics of experiments only presents kinematics (free surface coordinate histories) of what is happening. Data on stresses is inferred to clarify the kinetics of polymorphic transformation. The transition of iron to the epsilon phase happens in the initial section of the propagation of the shock wave. Hydrodynamic and molecular dynamics numerical simulations verify theoretical approach for the inferred stresses.