Laser Shocks: from Elastic-Plastic to Elastic Propagation Mode

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The genesis of complex elastic waves emitted from a hot spot produced by strong laser heating is studied. There is a connection/bridge between (A) laser shock wave (SW) peening by strong laser action and (B) linear optoacoustics associated with low amplitude laser exposure.
(A) Laser-induced hydrodynamics results in surface layer hardening. The laser heating leads to plume formation, melting, crater formation, formation of a dense dislocation field around the crater with residual deformations and stresses. At the same time, SWs running from the forming crater into the target pass from elastic-plastic regime of propagation to nonlinear elastic regime. Elastic SW are attenuated to linear elastic waves used in optoacoustics.
(B) Optoacoustics at the micro- and nanoscale, i.e. photon-phonon conversion, is in great demand for advanced applications of photon-phonon transducers in telecommunications, acoustic magnetization switches and in sensors (detection of elastic characteristics).
Near the hot spot with a plume, a zone of plastic deformations imprinted in the matter is formed. Elastic waves emitted from this spot have a complex mixed longitudinal-transverse polarization and consist of a combination of compression waves, rarefaction waves, vortex/shear waves and the surface Rayleigh wave.