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4P53 - 2D Simulations of the ns-Laser Shock Peening

Thursday 27 June 2019 16:00 (1h 30m)

Laser shock peening (LSP) is a widely known technique, which is used in industry to improve the properties and performance of metallic components. Laser induced compressive residual stresses (RS) allow to enhance the fatigue life of aircraft structures [1]. Due to deeper depth and higher magnitude of RS in the target material, this technique is a potential substitute of the conventional methods applied in industry, e.g. shot peening. In LSP short laser pulses (fs-, ps- and ns-ranges) with high intensity (usually $> 1\ \mathrm{GW/cm^2}$) are used to vaporize and ionize the thin surface layer of the target material. The fast expansion of this plasma plume induces a mechanical shock wave propagation, which causes microstructure changes and results in compressive RS generation.

Plasma formation and shock wave propagation are non-linear processes with extremely short time scales. Due to that, it is very difficult to optimize the LSP only based on experiments. Thus, simulation models are required. In our research, a 2D laser peening model is implemented in MULTI2D [2]. The temporal and spatial distributions of plasma parameters are determined for different laser intensities. Plasma behavior and a shock wave propagation are analyzed in order to understand the influence of different parameters on the occurred processes.

[1] R. Fabbro, P. Peyre, L. Berthe, X. Scherpereel, J. Laser Appl. **10** (6), 265–279 (1998)

[2] R. Ramis, J. Meyer-ter-Vehn, J. Ramírez, Comput. Phys. Commun. **180**, 977–994 (2009)

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