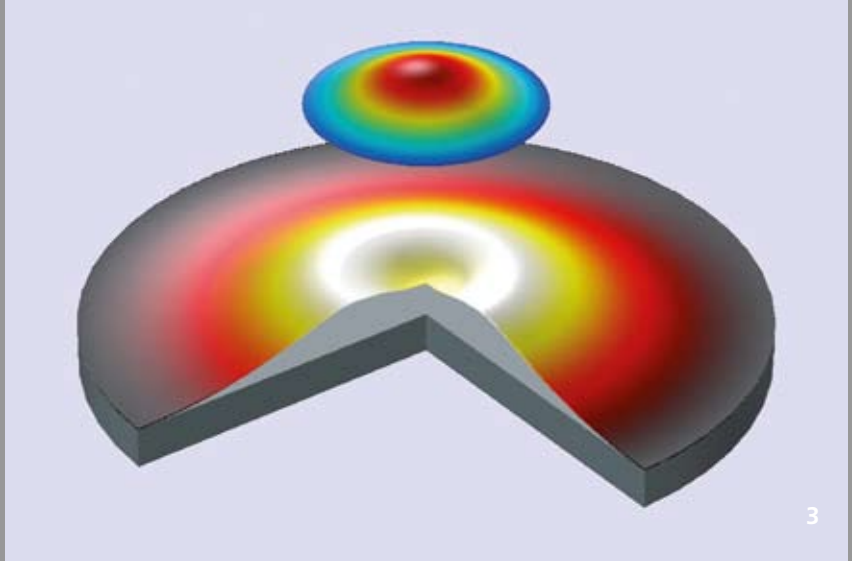

SIMULATING THE ABLATION OF THIN FILMS

Task

When thin films are ablated (e.g. in the semi-conductor industry) with ultra-short pulse durations and comparably small fluencies near the ablation threshold, efficient ablation occurs mainly on account of a thermo-mechanical effect of the laser radiation. The ablation takes place dominantly through bulging (delamination) and subsequent tearing of the bulged, stretched layer. In order to maintain the quality of a subsequent coating, semi-peeled coating remains and the effect of thermal phase transitions (melting, evaporation) have to be prevented, which, in particular, can be observed in the neighborhood of the ablation regions.

Method

The modelling and simulation aims to provide a spatially resolved depiction of the ablation of thin films so that the observed ablation threshold and the mechanical ablation process can be explained. For this purpose, both the dynamics of the electronic and phononic system are calculated in the solid state as are the thermo-mechanical effects within the workpiece.

Result

A model was used to simulate the deposition of the irradiated laser energy and the consequent mechanical deformation to the point at which the breaking stress was exceeded.

Applications

The simulation depicts the thermo-mechanical ablation of thin films on substrates. It can, thus, be used to simulate laser delamination processes, ones which use low power, thus for the manufacture of photovoltaic cells (P1, P2, P3 ablation) or for the cleaning of surfaces by means of laser radiation. In particular, this form of ablation is relevant when the underlying layers or substrates are only allowed to undergo a low thermal load or none at all.

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3 Simulation of a bulge.