K 6: Laserstrahlwechselwirkung, Lasermaterialbearbeitung I

Time: Thursday 11:30–12:00 Location: V57.04

K 6.1 Thu 11:30 V57.04

Dynamics of electrons in liquid water excited with an ultrashort VUV laser pulse — •Klaus Huthmacher and Bärbel Rethfeld — TU Kaiserslautern, Deutschland

In this work we present the theoretical study of the interaction of an ultrashort VUV laser pulse with liquid water. For the laser pulse we assume a gaussian shape with a duration of 25 fs and an average photon energy of 50 eV. These photons ionize water molecules generating free electrons, which further create secondary electrons due to ionization or interact via elastic collisions with other water molecules.
We use a kinetic Monte Carlo method to track each electron and its collisions event by event. In the first step we calculate the penetration depth of the photons. Next we evaluate the cross sections for the free electrons refering to ionization, elastic collisions and Auger recombination. Furthermore we compute mean free paths and finally we get the energy loss due to elastic collisions or the energy transfer to secondary electrons due to ionization.
As results we present time- and energetically resolved electron distributions.

K 6.2 Thu 11:45 V57.04

Modeling laser-induced dielectric breakdown: Application of the multiple rate equation — •Oliver Brenk and Bärbel Rethfeld — Technische Universität Kaiserslautern, 67663 Kaiserslautern, Germany

Material processing with ultrashort laser pulses is in the focus of experimental and theoretical research. Here the dielectric breakdown, a strong increase in the absorptivity of a former transparent dielectric, is of special interest. Due to the absorbed laser energy material modification can happen. A key player in the energy transfer from laser to lattice is the electronic system. Applying the multiple rate equation (MRE), introduced in [1], we investigate the temporal evolution of the electronic density in the conduction band. The MRE is a tool to numerically simulate the effects of ultrashort laser pulse irradiation on the electronic system of a dielectric. The inclusion of optical parameters, like surface reflectivity and refractive index, depending on the electronic density in the conduction band, enables us to investigate dielectric breakdown. Calculating the free electron density evolution during irradiation, we can trace absorption and breakdown. We follow the latter independent of the assumption of a certain critical electron density. The current implementation of the MRE includes a spatial dimension, thus we can estimate up to which depth breakdown occurs.

[1] B. Rethfeld. Phys. Rev. Lett., 92:187401, 2004.