K 8: Laser - Systeme und Anwendungen II

Zeit: Donnerstag 16:30–17:30 Raum: 3E

K 8.1 Do 16:30 3E

Spatial evolution of multiple filaments created in air by femtosecond laser pulses — •Gabriela Paunescu, Wolfgang Riede, and Gerhard Spindler — Deutsches Zentrum für Luft- und Raumfahrt, Institut für Technische Physik, Pfaffenwaldring 38-40, 70569 Stuttgart, Germany

The spatial evolution of filaments in air was experimentally investigated and compared with theoretical calculations. We used a new method to visualize the multi-filamentary-pattern along the laser propagation axis. This technique allows for the accurate determination of number and relative position of filaments across the beam cross section.

The experiments have been performed with a Ti:Sapphire chirped pulse amplification laser system. The laser operates at a center wavelength of 800 nm, with an energy per pulse up to 15 mJ and a repetition rate up to 100 Hz. The pulse duration was maintained 50 fs during the experiments. The corresponding peak power is 0.3 TW, which is about 100 times the critical power for self-focusing in air.

The measurements are in good agreement with numerical simulations of the pulse propagation starting from the measured intensity profile right behind the laser. Our nonlinear propagation equation comprises diffraction and self-focusing due to the optical Kerr effect. The defocusing effect of plasma generated by tunnel/multiphoton ionization is taken into account.

K 8.2 Do 16:45 3E

Picosecond acoustic response in fs-laser-excited Germanium: The role of electronic and thermal pressures — •Uladzimir Shymanovich, Matthieu Nicoul, Wei Lu, Stephan Kähle, Klaus Sokolowski-Tinten, Alexander Tarasevitch, and Dietrich von der Linde — Universität Duisburg-Essen, Institut für Experimentelle Physik, Lotharstr. 1, 47048 Duisburg

Time resolved X-ray diffraction makes it possible to directly observe changes in the lattice of solids induced by fs optical excitation. Here we discuss experiments on the picosecond acoustic response in thin films of Germanium, which allowed us to distinguish the thermal and electronic pressure contributions to the laser-generated pressure. In particular, it was found that the relative contribution of the electronic pressure strongly depends on the strength of optical excitation.

K 8.3 Do 17:00 3E

Ultrafast Dynamical Processes in Laser Pulse-Heated Metals — •Banaz Omar and Baerbel Rethfeld — Technical University of Kaiserslautern, Department of Physics, Erwin Schroedinger Str. 46, D-67663 Kaiserslautern, Germany.

The microscopic dynamical processes in ultrashort laser pulse-heated metals have been theoretically investigated. The collision terms of Boltzmann equation have been solved numerically, considering the inverse bremsstrahlung absorption, electron-electron collision and electron-phonon interaction. The transient non-equilibrium evolution of electron distribution function due to excitation and the subsequent thermalization of the free electrons is studied. In contrast to aluminum, with a free-electron like conduction band considered in [1], the d-band in gold lies within the conduction band at about 2.5 eV below the Fermi surface of free electrons in s-band. Therefore, secondary electrons may be excited strongly from the d-band, even for laser pulses with energy lower than 2.5 eV. We apply our kinetic approach to the case of gold by taking the electron density of states into account, and compare with the case of excitation of aluminum.

[1] B. Rethfeld, A. Kaiser, M. Vicanek, and G. Simon, Phys. Rev. B 65, 214303 (2002)

K 8.4 Do 17:15 3E

The interaction of laser light with silicon — •Aart Schoonderbeek, Oliver Haupt, Rainer Kling, and Andreas Ostendorf — Laser Zentrum Hannover e.V. (LZH), Hannover

During the last years, the photovoltaic industry has experienced enormous growth. However, for solar cells to be competitive on the longer term, both an increase in their efficiency as well as a reduction in costs is necessary. According to these demands, laser technology offers many possibilities to develop new processes and is even a key-technology for many novel solar cell designs. This presentation gives an impression of laser processing of the most important material in this field: silicon. Different laser types and some of the most important laser parameters for silicon processing, like the pulse duration and the wavelength, are discussed.