K 5: Laserstrahlwechselwirkung, Lasermaterialbearbeitung I

Zeit: Mittwoch 11:15–12:30 Raum: HS D

K 5.1 Mi 11:15 HS D

Short pulse laser ablation of metals in an ambient gas: a hydrodynamic simulation — •David Autrique — TU Kaiserslautern, Department of Physics, Erwin-Schrödinger-Straße 46,67663 Kaiserslautern

A hydrodynamic model is presented for short pulse laser ablation of Cu in a background gas. Material decomposition and laser induced phase transitions are modeled by means of a multi-phase equation of state (eos). The model describes the heating, melting and evaporation of the target, the target-vapor interaction in the boundary layer as well as the vapor dynamics. Comparison is made with experimental data from literature, whenever available, and in general, reasonable agreement was achieved between our model predictions and experimental results. Therefore, the model can be useful to predict trends in target and plume characteristics, which are difficult to obtain experimentally.

K 5.2 Mi 11:30 HS D

Long-Time Stability and Bleaching Behaviour of Fluorescent Defect Centres in fs-Laser-Written Waveguides — •Christian Vetter, Felix Dreisow, Matthias Heinrich, Stefan Nolte, and Andreas Tünnermann — Institute of Applied Physics, Friedrich-Schiller University Jena

The behaviour of fluorescent defect centres in fs-laser written waveguides has been studied using amorphous SiO_2 with a high content of silanol-groups as host material. A strong emission band at 650 nm originating from Non-Bridging Oxygen Hole Centres (NBOHCs) was used for direct fluorescence measurement.

We have studied the long-time stability (decay without additional illumination) and the bleaching behaviour (decay with illumination) of the sample and found multi-exponential decay-curves which indicate a complex system of chemical reactions. Additionally we measured a recovery mechanism which leads to the partial re-formation of NBOHCs after several hours.

K 5.3 Mi 11:45 HS D

Elektronendynamik in Festkörpern unter Bestrahlung mit einem ultrakurzen VUV Laserpuls — Nikita Medvedev[1,2] und •Baerbel Rethfeld[1] — [1]Technische Universität Kaiserslautern, Deutschland — [2]CFEL at DESY, Hamburg, Deutschland

Wird ein Festkörper mit einem ultrakurzen Laserpuls hoher Photonenenergie bestrahlt, so können Elektronen aus dem Valenzband oder tiefer liegenden atomaren Schalen in das Leitungsband angeregt werden. Auch sekundäre Stoßionisation und Anregung durch Auger–Zerfall von Löchern ist möglich. Wir berechnen mithilfe einer Monte Carlo Simulation die Anregung der Elektronen durch einen ultrakurzen VUV Laserpuls in festem Halbleitern und Metallen, am Beispiel von Silizium und Aluminium.

Wir erhalten den zeitlichen Verlauf der Dichte und Energieverteilung der angeregten Elektronen. Die Ergebnisse zeigen das Nichtgleichgewicht und die Thermalisierung des angeregten Elektronengases. Die transiente Dynamik und Energieverteilung der Elektronen hängt insbesondere auch von der Photonenenergie ab, während die gesamte absorbierte Energie eine untergeordnete Rolle spielt. In Halbleitern führen wir das Konzept der effektiven Bandlücke ein (effective energy gap, EEG [1]), mit der die Dichte der in das Leitungsband angeregten Elektronen abgeschätzt werden kann.

[1] N. Medvedev, B. Rethfeld, EPL **88**, 55001 (2009).

K 5.4 Mi 12:00 HS D

Two-Electron Control in Nonsequential Double Ionization — •Matthias Kübel[1], Boris Bergues[1], Nora G. Johnson[1,5], Kelsie J. Betsch[2], Robert R. Jones[2], Gerhard G. Paulus[3], Robert Moshammer[4], Joachim Ullrich[4], Ferenc Krausz[1], and Matthias F. Kling[1,5] — [1]Max-Planck-Institut für Quantenoptik, Garching, Germany — [2]University of Virginia, Charlottesville, VA, USA — [3]Friedrich-Schiller-Universität, Jena, Germany — [4]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [5]Kansas State University, Manhattan, KS, USA

During the past decade advances in ultrafast laser technology have made possible the generation of broad band laser pulses approaching the duration of a single optical cycle. Photoionization with such laser fields depends critically on the temporal form of the light wave, in particular on the carrier-envelope phase (CEP). Control over the CEP is therefore a powerful tool to study and manipulate electron dynamics on an attosecond time scale. Nonsequential Double Ionization (NSDI) of atoms is widely regarded as a prototype of correlated electron processes. Despite numerous experimental and theoretical studies the underlying mechanisms are not fully understood. By combining the recently developed CE phase-tagging technology with a Reaction Microscope, CEP-resolved measurements of two-electron correlation spectra of NSDI in a near-single-cycle laser field are performed. We observe dramatic dependence of the electron emission direction on the CEP.

K 5.5 Mi 12:15 HS D

Dynamics of free electron plasma produced by shaped ultrashort laser pulses — Cristian Sarpe, Jens Köhler, •Nadine Götte, Jutta Mildner, Dirk Otto, Matthias Wollenhaupt, and Thomas Baumert — Universität Kassel, Institut für Physik und CINSaT, Heinrich-Plett-Str. 40, D-34132 Kassel, Germany

The first step in the process of laser ablation of dielectric materials is the laser induced optical breakdown in which high density free electron plasma is created. A better knowledge of the plasma dynamics [1] can contribute to increase the precision of the ablation process and to reduce the collateral damage. We have shown that tailored ultrashort laser pulses are suitable to increase the precision of ablation one magnitude order below the optical diffraction limit in the case of high band gap solid dielectrics [2, 3]. Here we present our studies to investigate the dynamics of free electron plasma created by shaped femtosecond pulses in a thin water jet by using a robust spectral interference technique. The phase shift between a reference and a probe pulse produced in common-path interferometer give accurate information about the density of free electron plasma. The temporal evolution of the plasma is accurately observed and its dependence on the laser intensity and temporal pulse shapes is analysed.

[1] C. Sarpe et al. Appl. Phy. Lett. 88, 2161109 (2006)
[2] L. Englert et al. Opt. Express 15, 17855 (2007)
[3] L. Englert et al. Appl Phys A 92, 749 (2008)