K 4: Laser-Materie-Wechselwirkung und Laseranwendungen I

Time: Tuesday 11:15–12:15 Location: SPA SR203

K 4.1 Tue 11:15 SPA SR203

Laser-induced cavitation bubbles near surfaces — Christian Menninger[1,2], Marvin Tammen[1,2], •Yun Kai[1], Bernd Meyerer[1], Walter Garen[1], and Ulrich Teubner[1,2] — [1]Institut für Lasertechnik Ostfriesland, Hochschule Emden/Leer, University of Applied Sciences, Constantiaplatz 4, 26723 Emden, Germany — [2]Institut für Physik, Carl von Ossietzky Universität Oldenburg, 26111 Oldenburg, Germany

Applying a nanosecond frequency-doubled Nd:YAG laser, cavitation bubbles can be induced in liquids. During the evolution process of the bubbles, shock waves can be generated. Within the scope of the experiments, cavitation bubbles are generated near the liquid (currently distilled water) surface. The interaction between the shock waves and the liquid surface is studied. Using shadow procedure, the water jet on the surface and the rarefaction waves are investigated with a high-speed CCD camera together with a second Nd:YAG laser as light source. The phenomena observed in these experiments are analogues to those that may be present in turbines or hydraulic systems.

K 4.2 Tue 11:30 SPA SR203

Laser-induced shock waves in glass capillary — Marvin Tammen[1,2], Christian Menninger[1,2], •Yun Kai[1], Bernd Meyerer[1], Walter Garen[1], and Ulrich Teubner[1,2] — [1]Institut für Lasertechnik Ostfriesland, Hochschule Emden/Leer, University of Applied Sciences, Constantiaplatz 4, 26723 Emden, Germany — [2]Institut für Physik, Carl von Ossietzky Universität Oldenburg, 26111 Oldenburg, Germany

Shock waves in spherical geometry in liquid can be generated after the optical breakdown induced by intense laser pulses. In the scope of the on-going experiments, the optical breakdown is designed to occur in different glass capillaries (several millimeters as inner diameter), which are placed in a glass cuvette filled with liquid (distilled water in present work). External pressure is applied into the capillary to control the position of the air-water boundary. The propagation of the shock waves within the capillary and the resulting evaporation process are investigated by applying optical ultra short time measurement techniques. The study of the velocity of the shock waves propagating in capillaries of different diameters and in different liquids is carried out. The acquired results contribute to the further understanding of shock wave dynamics, which is of interest for applications such as micro fluidics, nano technology, medical physics and many other topics.

K 4.3 Tue 11:45 SPA SR203

Nonthermal melting in semiconductors under X-ray free-electron laser pulse irradiation — •Nikita Medvedev[1], Harald Jeschke[2], and Beata Ziaja[1] — [1]Center for Free-Electron Laser Science, Deutsches Elektronen-Synchrotron DESY, Notkestrasse 85, D-22607 Hamburg, Germany — [2]Institut für Theoretische Physik, Goethe-Universität Frankfurt am Main, Max-von-Laue-Strasse 1, D-60438 Frankfurt, Germany

After irradiation of a covalently bonded material with a femtosecond intense X-ray pulse, one can observe an ultrafast nonthermal melting occurring on sub-picosecond timescale. Such melting is induced by a modification of the interatomic potential, triggered by the electron excitation. We studied such process in detail with newly developed hybrid approach MC-TBMD [1-3]. It revealed the multistep nature of the nonthermal melting: an interplay between the high-energy electron relaxation, bandgap collapse and modification of the electronic structure, and atomic relaxation into the new phase. We calculated the damage threshold of the nonthermal graphitization of diamond as a function of photon energy within a wide energy range: from a few eV up to tens of keV [2,3]. It appeared that the higher the photon energy, the longer it takes for the atomic relaxation and the subsequent phase transition [3].

[1] N. Medvedev, H. Jeschke, B. Ziaja, New J. Phys. 15, 015016 (2013)

[2] J. Gaudin et al., Phys. Rev. B 88, 060101 (2013)

[3] N. Medvedev, H. Jeschke, B. Ziaja, Phys. Rev. B (2013 in press)

K 4.4 Tue 12:00 SPA SR203

Laser-induced thermal neutron production at high repetition rates using novel cluster/gas targets — •Friederike Schlüter[1], Thomas Brückel[4], Markus Büscher[1], Mirela Cerchez[5], Laura Di Lucchio[3], Ilhan Engin[2], Paul Gibbon[3], Patrick Greven[2], Silke Grieser[6], Astrid Holler[2], Alfons Khoukaz[6], Esperanza Köhler[6], Ulrich Rücker[4], Julian Sohn[6], Toma Toncian[5], and Oswald Willi[5] — [1]Peter Grünberg Institut (PGI), FZ Jülich — [2]Institut für Kernphysik (IKP), FZ Jülich — [3]Jülich Supercomputing Centre (JCHP), FZ Jülich — [4]Jülich Centre for Neutron Science (JCNS), FZ Jülich — [5]Institut für Laser-Plasma Physik (ILPP), Heinrich-Heine Universität Düsseldorf — [6]Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

The physics of laser driven particle sources has undergone great developments in recent years. With increasing laser powers it is nowadays possible to accelerate particles to multi-MeV kinetic energies. Such proton and deuteron beams can be used to generate short MeV neutron pulses in a secondary converter made, e.g., from Be [Roth]. Using a novel target concept, we want to realize a high repetition rate thermal neutron source at the 300 TW 10 Hz Düsseldorf ARCturus laser facility. For that purpose a source for frozen H_2 or D_2 clusters - each with up to 10^6 molecules - has been prepared at Münster University which will be combined with a conventional gas jet. In a first measurement in 2014 we will optimize the p and d fluxes from the cluster/gas target, and then build tailored (i.e. compact) neutron converter targets and moderators to deliver intense neutron pulses at meV energies.