K 6: Poster

Time: Thursday 16:30–19:00 Location: Lichthof

K 6.1 Th 16:30 Lichthof

Properties of magnetic materials at very-high magnetization rates — Byung-Joon Lee[1], •Christian Teske[1], Isfried Petzenhauser[2], Marcus Iberler[1], Joachim Jacoby[1], and Udo Blell[2] — [1]Institut für Agewandte Physik, Goethe Universität, Frankfurt — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt

The use of magnetic materials is increasing in pulsed power systems. To optimize those applications, it is necessary to know the behavior of magnetic materials when their magnetizations reversal time is in the order of 100 ns or less. In the manufacturers datasheets, the magnetization behavior of magnetic materials is usually given for low frequencies (kHz range or below). To find useful data for high speed magnetic field applications, several types of magnetic materials (amorphous alloys, MnZn and NiZn) were experimentally investigated and compared. In this presentation, the material characterizations, such as B-H curve and losses, are described under magnetic reversal velocity of about 30 Tesla per microsecond. Finally, as an important application, those materials were tested as a saturating inductor to improve the capabilities of gas switches.

K 6.2 Th 16:30 Lichthof

Vakuum-Ultraviolett (VUV) Emission elektronenstrahlunterstützter Hochfrequenzentladungen. — •Thomas Dandl[1], Thomas Heindl[1], Alexander Fedenev[2], Reiner Krücken[1], Jochen Wieser[3] und Andreas Ulrich[1] — [1]Physik Department E12, Technische Universität München — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — [3]Optimare GmbH, Wilhelmshaven

Durch die Verwendung extrem dünner (300 nm) Eintrittsfenster aus Siliziumnitrid ist es gelungen, Elektronenstrahlen mit relativ niedriger Teilchenenergie von typisch 12 keV in Gase einzukoppeln [1]. Dies führt zu einer starken Vorionisation, die es ermöglicht, quasi ohne Zündbedingungen zusätzlich zur Teilchenstrahlanregung Energie in Form einer Hochfrequenz (HF)- Entladung in das Gas einzukoppeln. Bei der Elektronenstrahlanregung von Edelgasen dominiert das sog. zweite Excimerkontinuum die Lichtemission im vakuumultravioletten Spektralbereich [2]. In Vorversuchen war beobachtet worden, dass zusätzliche HF Anregung zu verstärkter Emission des sog. ersten Kontinuums bei jeweils kürzeren Wellenlängen führt. Es werden systematische Untersuchungen und mögliche Anwendungen elektronenstrahlunterstützter HF Entladungen vorgestellt und vorläufige Interpretationen zu den beobachteten Effekten gegeben.

[1] J. Wieser et al., Rev. Sci. Instrum. 68, 1360-1364, 1997
[2] A. Morozov, et al. J. Appl. Phys. 103 (2008) 103301

K 6.3 Th 16:30 Lichthof

Atmosphärische Plasmajet-Präzisionsbearbeitung von optischen Materialien — •Hendrik Paetzelt[1], Georg Böhm[1], Thomas Arnold[1], Axel Schindler[1] und Martin Weiser[2] — [1]Leibniz-Institut für Oberflächenmodifizierung e.V., Permoserstr. 15, D-04318 Leipzig — [2]Carl Zeiss SMT AG, D-73446 Oberkochen

Reaktive atmosphärische Plasmajets haben ein hohes technologisches Potential zur lokalen Formgebung und Formkorrektur für die verschiedensten Materialien (Quarz, Si, ULE). Es werden Ergebnisse zur Präzisions-Oberflächenformgebung mit hoher Abtragsrate und μm-Genauigkeit und zur Präzisionsoberflächenkorrektur mit geringen Halbwertsbreiten des Bearbeitungswerkzeuges und nm Genauigkeit einer mikrowellen-angeregten Plasmaquelle vorgestellt. Bei einer Anregungsfrequenz von 2,45 GHz wird hierbei ein Ar/He-Plasma erzeugt, welches in Verbindung mit dem Reaktivgas CF_4 zur Bearbeitung von Quarz und anderen siliziumhaltigen Materialien wie ULE und Silizium genutzt wird. Dabei kann die Halbwertsbreite des Plasmajets über ein Blendensystem in einem Bereich von mehreren mm bis zu 500 μm variiert werden. Die Plasmajetparameter wie: Halbwertsbreite, Tiefenrate, Volumenrate wurden in Abhängigkeit von Gaszusammensetzung, Plasmaleistung und Bearbeitungsparametern (Abstand zur Oberfläche, Fahrgeschwindigkeit, Vorschub) experimentell bestimmt. Zudem wurde eine Parameteroptimierung im Hinblick auf die Stabilität der Abtragsfunktion durchgeführt und ihr Einfluss auf die Oberflächenbearbeitung an Modellflächen charakterisiert.

K 6.4 Th 16:30 Lichthof

Lateral investigation of a filament by using a semi-inifinite gas cell — Emilia Schulz[1,2], •Daniel S. Steingrube[1,2], Thomas Binhammer[1,3], Uwe Morgner[1,2,4], and Milutin Kovacev[1,2] — [1]Instutut für Quantenoptik, Leibniz Universität Hannover, Germany — [2]QUEST, Center for Quantum Engineering and Space-Time Research, Hannover, Germany — [3]VENTEON Laser Technologies GmbH, Hannover, Germany — [4]Laser Zentrum Hannover, Germany

The semi-infinite gas cell concept [1,2] is a promising geometry for high-order harmonic generation due to high conversion efficiency and the ability of handling relatively high pressure of several 100 mbar. We present a cell design which is capable to realize a pressure gradient from 1000 mbar argon to a vacuum pressure of below 10-4 mbar over a distance of about 1 cm. Beside harmonic generation at very high pressures this enables the lateral investigation of filaments in propagation direction. Self focusing and spectral broadening of the pulse during the filamentation process can now be investigated. First results are shown.

[1] N. Papadogiannis, Appl. Phys. B 73, 687-692 (2001)
[2] D. S. Steingrube, PRA 80, 043819 (2009)

K 6.5 Th 16:30 Lichthof

Femtosecond VUV and Soft X-Ray Pulses for Surface Spectroscopy — •Robert Carley[1], Kristian Döbrich[1], Cornelius Gahl[1], Martin Teichmann[1], Kai Godehusen[2], Olaf Schwarzkopf[2], Frank Noack[1], Philippe Wernet[2], and Martin Weinelt[1,3] — [1]Max-Born-Institut, Max-Born-Straße. 2A, 12489 Berlin, Germany — [2]Helmholtz-Zentrum für Materialien und Energie, Elektronenspeicherring BESSY II, Albert-Einstein-Straße 15, 12489 Berlin, Germany — [3]Fachbereich Physik der Freien Universität Berlin, Arnimallee 14, 14195 Berlin, Germany

We present initial characterization results of a newly developed high-order harmonics (HHG) VUV beamline. It will be used to perform time-resolved studies of metal- and semiconductor surfaces, and gas-phase molecular systems, and we show our first photoemission spectra from the W (110) surface. The HHG source is driven by the output of a commercial Ti-sapphire multipass laser amplifier generating 40 fs pulses at a repetition rate of 10 kHz, focused into an Ar-filled gas cell to create high-order harmonics. Following separation from the IR with an Al foil filter, a toroidal mirror images the HHG source onto the entrance slit of a toroidal grating monochromator, which selects a particular harmonic and the bandwidth of the transmitted radiation. A second toroidal mirror images the output slit of the monochromator onto the experimental sample housed in a custom-built UHV chamber equipped with a image-type hemispherical electron kinetic energy analyser. The VUV can be combined with a time-delayed IR pump beam from the driving laser in order to perform time-resolved measurements.

K 6.6 Th 16:30 Lichthof

Unique phase retrieval of ultrafast optical fields — •Karsten Sperlich[1], Birger Seifert[2], and Heinrich Stolz[1] — [1]Institut für Physik, Universität Rostock, D-18051 Rostock, Germany — [2]Facultad de Física, Pontificia Universidad Católica de Chile, Casilla 306, Santiago 22, Chile

A self-referencing technique for measuring amplitude and phase of ultrashort laser pulses is presented. In contrast to other methods the relative-phase ambiguities do not appear in our method. Thus, we can characterize ultrashort pulses with well-separated frequency components. The relative-phase ambiguities can be avoided by the use of a cross-correlation technique with two independent laser pulses. Further we propose and demonstrate experimentally a new real-time phase-retrieval algorithm that reconstructs both pulses fast and uniquely. Beyond that we give details about the used multi shot setup and our new concept of a single shot setup.

K 6.7 Th 16:30 Lichthof

Microstructuring of Various Materials using Femtosecond Laser Pulses — •Andy Engel[1], Manuel Pfeiffer[1], Steffen Weissmantel[1], Hagen Grüttner[1], and Günter Reisse[2] — [1]Hochschule Mittweida, Technikumplatz 17, 09648 Mittweida, Germany — [2]Laserinstitut Mittelsachsen e.V., Technikumplatz 17, 09648 Mittweida, Germany

New results on three-dimensional micro-structuring of tungsten carbide hard metal, steel, copper and brass using femtosecond laser pulses will be presented. For the investigations, a largely automated high-precision fs-laser micromachining station was used. The fs-laser beam is focussed onto the sample surface using different objec-tives. The investigations of the ablation behaviour of the various materials in dependence of the laser processing parameters will be presented in the first part of the presentation. In the second part, complex 3D microstructures with a variety of geometries and resolutions down to a few micrometers showing smooth side walls as well as steep wall angles and the parameters which were found to be optimum for the microstructuring of each material will be presented. It will be shown that ultrashort laser pulses are suitable for high-precision micromachining of metals. Nearly no heat affected zones next to the laser processed microstructures and, in the case of the sintered hard metal, no decomposition or segregation due to the fs-laser action was observed.

K 6.8 Th 16:30 Lichthof

Pathways leading to ultrafast melting of silicon — Eeuwe S. Zijlstra, •Tobias Zier, Bernhard Reuter, Bernd Bauerhenne, and Martin E. Garcia — Theoretische Physik, Universität Kassel, Heinrich-Plett-Str. 40, 34132 Kassel, Germany

When silicon is excited by a sufficiently intense ultrashort laser pulse, it is known to melt within a picosecond. The femtosecond excitation induces a nonequilibrium state with hot electrons (several 10 000 K) and cold ions (near room temperature). On the basis of density functional theory we study this phenomenon and pay particular attention to the changes of the interionic potential with respect to thermal equilibrium (the ground state). The pathways involved in the ultrafast melting of Si are studied from two complementary points of view, namely, using the phononic degrees of freedom and performing molecular dynamics simulations. Our results allow us to give a microscopic picture of the first stages of the ultrafast melting as well as of the subsequent dynamics.

K 6.9 Th 16:30 Lichthof

Determining the Carrier-Envelope Phase of short intense laser pulses and Radiation Reaction below the Radiation-Dominated Regime — •Felix Mackenroth, Antonino Di Piazza, and Christoph H. Keitel — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg (Germany)

The electromagnetic radiation emitted by an ultrarelativistic accelerated electron is sensitive to the precise shape of the field driving the electron. We show that the angular distribution of the photons emitted by an electron via multiphoton Compton scattering off a strong, short laser pulse provides a direct way of determining the Carrier-Envelope Phase of the driving laser field [1]. The presented calculations take into account relativistic as well as quantum effects.

We also consider the classical effect of Thomson scattering and present a scenario in which the laser pulse on average passes a momentum to the electron comparable to the one initially prepared. This configuration turns out to be far more sensitive to Radiation Reaction (RR) than previously studied settings. As a consequence, it will be possible to experimentally investigate RR with currently available laser systems [2].

[1] F. Mackenroth, A. Di Piazza, and C. H. Keitel, in preparation.

[2] A. Di Piazza, K. Z. Hatsagortsyan, and C. H. Keitel, Phys. Rev. Lett. **102**, 254802 (2009).

K 6.10 Th 16:30 Lichthof

Spectral interference to investigate the dynamics of the free electron plasma excited via tailored fs-pulses — •Cristian Sarpe-Tudoran, Matthias Wollenhaupt, Alexander Horn, Jens Köhler, Lars Englert, and Thomas Baumert — Universität Kassel, Institut für Physik und CINSaT, Heinrich-Plett-Str. 40, D-34132 Kassel, Germany

In the process of laser ablation of high band gap materials the first step is the laser induced optical breakdown in which a high density free electron plasma is created. We have shown that by using tailored ultrashort laser pulses the optical breakdown can be manipulated in order to increase the precision of the ablation process about one order below diffraction limit [1]. A better knowledge of the temporal evolution of the plasma density [2] can provide information on the ionization mechanisms involved in the breakdown process; based on this, fs-pulses can be shaped in order to improve the ablation process further. Here we report our studies to investigate the dynamics of the plasma created by fs-laser pulses in a thin water jet by using a robust spectral interference technique. Information about the density of the free electrons produced by tailored pump pulses can be accurately obtained by analyzing the phase shift between a reference and a probe pulse produced in a common-path interferometer. The early times dynamics is obtained with a high temporal resolution as well as its dependence on the laser intensity and temporal pulse shapes.

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