K 9: Laseranwendungen und Lasermaterialbearbeitung III

Zeit: Donnerstag 16:30–17:15 Raum: HS 4

K 9.1 Do 16:30 HS 4

a laser-driven nanosecond proton source for radiobiological studies — •jianhui bin[1,2], klaus allinger[1,2], walter assmann[1], guido a. drexler[3], anna a. friedl[3], dieter habs[1], peter hilz[1], nicole humble[4], daniel kiefer[2], wenjun ma[1], doerte michalskai[4], michael molls[4], sabine reinhardt[1], thomas e. schmid[4], olga zlobinskaya[4], joerg schreiber[1,2], and jan j wilkens[4] — [1]Faculty of Physics, Ludwig-Maximilians-Universitaet Muenchen, Am Coulombwall 1, 85748 Garching, Germany — [2]Max Planck Institute of Quantum Optics, Hans-Kopfermann-Str. 1, 85748 Garching, Germany — [3]Department of Radiation Oncology, Ludwig-Maximilians-Universitaet Muenchen, Schillerstr. 42, 80336 Muenchen, Germany — [4]Department of Radiation Oncology, Technische Universitaet Muenchen, Klinikum rechts der Isar, Ismaninger Str. 22, 81675 Muenchen, Germany

Ion beams are relevant for radiobiological studies and for tumor therapy. In contrast to conventional accelerators, laser-driven ion acceleration offers a potentially more compact and cost-effective means of delivering ions for radiotherapy. Here we show that by combining advanced acceleration using nanometer thin targets and beam transport, truly nanosecond quasi-monoenergetic proton bunches can be generated with a table-top laser system, delivering single shot doses up to 7 Gray to living cells. Although in their infancy, laser-ion accelerators allow studying fast radiobiological processes as demonstrated here by measurements of the relative biological effectiveness of nanosecond proton bunches in human tumor cells.

K 9.2 Do 16:45 HS 4

Analysis of the hole formation in ultrashort pulse laser deep drilling — •Sven Döring[1], Tobias Ullsperger[1], Sören Richter[1], Andreas Tünnermann[1,2], and Stefan Nolte[1,2] — [1]Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Germany — [2]Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

We present a detailed experimental study of the hole formation process during ultrashort pulse laser deep drilling in silicon by in-situ imaging. This technology allows to directly follow the evolution of the hole shape inside a material which is opaque for the drilling radiation. Our observations show three characteristic phases of the drilling process for all parameters. At first, the hole capillary is excavated with high reproducibility. In a second phase, the drilling rate undergoes statistical variations which involve the formation of imperfections like bulges and multiple hole ends. Finally, forward drilling stops and only the diameter of the hole can increase further. Our investigation of the influence of process parameters like pulse energy and focus position on this behavior revealed an increase of the achievable hole depth up to a factor of 2 by optimizing the focus position, while minimizing the statistical variations.

K 9.3 Do 17:00 HS 4

Molecular Dynamics Modeling of Short Laser Pulse Nanostructuring of Metals on the Experimental Scale — •Dmitry Ivanov[1,2], Vladimir Lipp[1,2], Baerbel Rethfeld[1], and Martin Garcia[2] — [1]Technische Universitaet Kaiserslautern, Erwin-Schrödinger-Straße 46, 67663 Kaiserslautern — [2]University Kassel, Heinr.-Plett-Straße 40, 34132 Kassel

Short laser pulse surface nanoprocessing involves a number of concurrent fundamental physical processes. Due to different time and spatial scales of their activation it makes them difficult to study within the frames of a single computational approach and in the experimental analysis as well [1]. A transient character of the nonequilibrium states of matter induced with a short laser pulse hampers the applicability of continuum models, but classical Molecular Dynamics simulations are usually limited in the system sizes. In this work the MD-based model implemented in parallel algorithm and utilized in a coupling with a continuum description of the photo-excited free carrier's dynamics is extended to the scale directly accessible in the experiment [2]. The experimental data are then for the first time directly compared with the model predictions. The mechanisms responsible for the short laser pulse surface nanostructuring of metals are considered in the complex dynamics of competing processes simultaneously involved into the process. The modeling revealed a very good agreement with the experiment and predicted a new phenomenon potentially affecting the optical properties of material. [1] A.I. Kuznetsov et. al.,Appl Phys. A 94, 221 (2009). [2] D.S. Ivanov et. al., Appl. Phys. A. 92, 791 (2008).