DAMAGE OF SOLIDS INDUCED BY SINGLE PULSES OF XUV-FLASH

J.B. Pełka [1], R. Sobierajski [1], M. Jurek [1], J. Krzywiński [1], D. Żymierska [1], D. Klinger [1], S. Hau Riege [2], H. Chapman [2], R. London [2], L. Juha [3], J. Chalupsky [3], J. Cihelka [3], U. Jastrow [4], K. Tiedtke [4], S. Toleikis [4], H. Wabnitz [4], W. Caliebe [4], K. Sokolowski-Tinten [5], N. Stojanovic [5], C. Riekel [6], R. Davies [6], M. Burghammer [6], W. Paszkowicz [1], and A. Wawro [1]

[1] *Institute of Physics, Polish Academy of Sciences, Al. Lotnikow 32/46, 02-668 Warsaw, Poland*
[2] *Lawrence Livermore National Laboratory, 7000 East Avenue, Livermore, CA 9455, USA*
[3] *Institute of Physics, Academy of Sciences of the Czech Republic, Na Slovance 2, 182 21 Prague, Czech Republic*
[4] *Deutsches Elektronen-Synchrotron DESY, Notkestrasse 85, D-226 3 Hamburg, Germany*
[5] *Institut für Experimentelle Physik, Universität Duisburg-Essen, Lotharstr. 1, 4748 Duisburg, Germany*
[6] *European Synchrotron Radiation Facility, 6 rue Jules Horowitz, BP 220, 38043 Grenoble, France*

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**) e-mail: pelkay@ifpan.edu.pl*

The VUV- and XUV-FEL beam interaction with matter has been extensively investigated for the last few years with a special attention paid to the damage induced in solids. Most of this work was performed with the Free electron LASer in Hamburg (FLASH). This new type of the IVth generation SR source delivers intense pulses of coherent light in the wavelength range of 6 - 50 nm with the unique combination of quantum energy, extreme short pulse duration of only 25 fs and high power/pulse up to 5 GW. Application of the radiation opens up an access to study not yet explored phenomena, remaining unattainable with classical sources.

Interaction of XUV FLASH pulses with solids can change optical properties of the materials and induces complex damage processes leading to the formation of specific morphological structures with sizes on micrometric and nanometric scales [1, 2]. The absorbed pulse energy can also provoke phase transitions that change composition or crystalline state of the near-surface material [3]. Investigation of these phenomena is crucial for refinement of theoretical models, necessary to predict performance and lifetime of optical components for the new generation of FELs operating in the XUV and X-ray region.

In this work we put together some of our important experimental results, obtained with aid of various techniques, on the interaction of high intensity (10^{11} –10^{14} W/cm^2) ultrashort pulses, delivered by FLASH, with solids. The one-color pump and probe technique made it possible to probe fluency-dependent variations in the optical constants of materials on the time scales of a single pulse duration.

The dynamics of ablation process was studied on the sample surface by the two-color pump and probe method with aid of an external optical laser. A detailed *ex-situ* characterization of irradiation-induced modifications on the solid surfaces was obtained by mixing the traditional microscopic methods with AFM. The x-ray microdiffraction with submicrometer beam was applied to probe the crystalline state with lateral resolution of only 250 nm.

By combining the results obtained with various experimental techniques, a more comprehensive picture of the processes in solids excited by an intense femtosecond XUV pulse was achieved.

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