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X-RAY TOPOGRAPHIC INVESTIGATION OF THE DEFORMATION FIELD AROUND SPOTS IRRADIATED BY FLASH SINGLE PULSES

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The important problem in the experiment performed with the intense fourth generation X-ray sources are the damages of the examined samples caused by the high energy impact. The effect introduced by the beam from the FLASH source in crystalline silicon and gallium arsenide samples was studied with synchrotron white beam projection and section topography enabling the evaluation of the strain field associated with the damages.

The silicon and GaAs crystal wafer samples were irradiated in an UHV chamber at a beamline BL2 of the FLASH facility by single pulses at wavelength of λ = 32.5±0.5 nm with pulse duration of τ = 25±0.5 fs. The pulse energy was up to 10 mJ. The beam was focused surface-normal onto the sample using a grazing-incidence carbon-coated ellipsoidal mirror, external to the chamber. Some structural properties of analogous spots were studied with the synchrotron microdiffraction method [1,2].

The samples were studied in back-reflection geometry by means of white beam projection topograph at F1 experimental station of DORIS III in HASYLAB. A relatively small glancing angle of 4^o, and in case of section topographs a 5 μm narrow slit was used. The topographs were taken for the azimuths differing through 90^o, and in the case of section topographs also for slightly altered positions of the incident beam.

Both the section and projection experimental topograps revealed significant extinction contrast coming from the vicinity of the irradiated spot. It was confirmed that the contrast around each of the spots is practically not changing for various azimuths. Apart from the extinction contrast the section topographs exposed along the longer side of the silicon sample revealed the interference fringes characteristic for the elastically bent samples.

It was possible to obtain a reasonable similarity of the presently recorded section images of some spots to the numerically simulated images of the rod-like defects using recently developed numerical procedure described in [3] (see Figs. 1 and 2).

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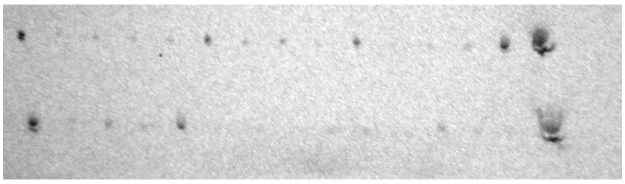

Figure 1. The fragment of Bragg-case white-beam diffraction topograph of the spots irradiated in silicon sample by FLASH single pulses.

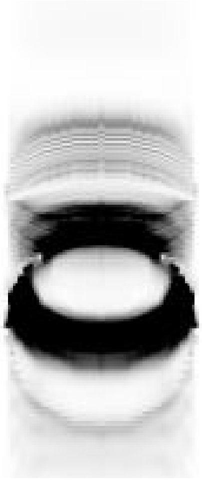

Figure 2. The simulated Bragg-case section image of the rod-like inclusion in silicon.