MS40-P11 | BEAM DAMAGE OF SINGLE SEMICONDUCTOR NANOWIRES DURING X-RAY NANO BEAM DIFFRACTION EXPERIMENTS

Pietsch, Ullrich (University of Siegen, Siegen, GER); AlHassan, Ali (University of Siegen, Siegen, GER); Davtyan, Arman (University of Siegen, Siegen, GER); Bahrami, Danial (University of Siegen, Siegen, GER); Bertram, Florian (DESY - Photon Science, Hamburg, GER)

Nano X-ray diffraction (nXRD) using focused synchrotron radiation is a powerful technique to study the structural properties of individual semiconductor nanowires (NWs). However, due to of focusing the highly intense radiation down to a footprint of less than 100 x 100nm² high radiation dose is deposited into a small sample volume which may cause radiation damage during measurements requesting long exposure time. Here, we report on nXRD experiments carried out at semiconductor NWs which are supposed to be resistant against radiation damage. The experiment has been performed under ambient conditions at the microfocus station of the P08 beamline at 3rd generation source PETRA III. Individual NWs were monitored continouosly over a time interval up to 5 hours recording reciprocal space maps (RSM) of the 111 Bragg reflection at the same spatial position. For exposure time of about 1h we observe a reduce in integral intensity accompanied by minor axial lattice expansion and small tilts of the NW axis with respect to the substrate normal. NWs exposed for more than 2 hours show an increase of lattice expansion and after 3 and more hours of exposure we see NW melting. SEM after nXRD displays formation of amorphous shell around the NW which is maximum at the position of exposure. Our findings are explained by the huge energy impact into a small NW volume due to massive generation of electrons and subsequent electron-phonon interaction.