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Surface and structural modifications in Bi nanowires induced by swift heavy ion irradiation

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The influence of swift heavy ion radiation on nanostructures has attracted increasing interest in recent years. To systematically explore size-effects on the interaction of swift heavy ions with nanowires, we have synthesized Bi nanowires with tailored diameter between 20 and 400 nm by electrodeposition in etched ion track membranes. These nanowires were irradiated at the GSI linear accelerator UNILAC with Au-ions of specific energy 8.3 MeV/u. Post-irradiation analysis with scanning electron microscopy (SEM) and transmission electron microscopy (TEM) revealed diameter dependent surface and structural modifications in the wires. In thin wires (diameter 20 to 50 nm) distinct ion tracks are visible as density contrast in TEM images. High-resolution TEM images prove complete recrystallization of the track region. Comparison between the experimental results to Molecular Dynamics (MD) simulations using the thermal spike model, allows us to assign this density contrast to hollow cavities that are formed inside the wires upon sputtering and atomic displacements. For thicker wires, above 100 nm diameter, SEM images reveal craters formed on the nanowires surface that are not present in the thinner wires.

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