Flow of Molten Material and Recrystallization Explains the Swift Heavy Ion Shape Transformation of Au Nanoclusters

A. A. Leino[1] O. H. Pakarinen[1] F. Djurabekova[1] K. Nordlund[1] P. Kluth[2] M. C. Ridgway[2]

[1]Helsinki Institute of Physics and Department of Physics, University of Helsinki
[2]Research School of Physics and Engineering, Australian National University

Heavy ions accelerated to very high kinetic energies Ekin > MeV / amu can be used to transform the shape of metal nanoclusters with diameters 5-30 nm into elongated ones not easily achievable by other means. This effect is analogous to the well established possibility to use multiwall carbon nanotubes inside an electron microscope as pressure vessels to modify and study the properties of metal nanoclusters. The swift ion processing has, however, the major advantage that the end result is stable over macroscopic timescales when taken out of the experimental processing chamber. Using atom-level multiscale modelling and experiments, we show here that the elongation is caused by melting and subsequent flow of initially crystalline metal into an underdense ion track core. The minor axis of the elongated particle is shown to saturate at a width comparable to the width of the ion track, in good agreement with the experiments.