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Nanopore Sculpting with Low Energy Ion Beam of Noble Gases
QUN CAI[1], Fudan Univercity, China, BRAD LEDDEN, University of Arkansas, ERIC KRUEGER, University of Arkansas, JENE GOLOVCHENKO, Harvard University, JIALI LI, University of Arkansas, JENE GOLOVCHENKO COLLABORATION — Experiments show that 3keV Helium, Neon, Argon, Krypton, and Xenon ion beams can be used to controllably "sculpt" nanoscale features in silicon nitride films using a feedback controlled ion beam sculpting apparatus. Here we report nanopore ion beam sculpting effects that depend on the inert gas ion species. We demonstrate that: (1) all the noble gas ion beams enable single nanometer control of structural dimensions in nanopores; (2) every ion species above shows similar ion beam flux dependence of nanopore formation, (3) the thickness of nanopores sculpted with different inert gas ion beam is deferent. Computer simulations (with SRIM and TRIM) and an "adatom" surface diffusion model are employed to explain the dynamics of nanoscale dimension change by competing sputtering and surface mass transport processes induced by different ion beam irradiation. These experiments and theoretical work reveal the surface atomic transport phenomena in a quantitative way that allows the extraction of parameters such as the adatom surface diffusion coefficients and average travel distances.

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