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Atomic-scale thermocapillary flow in focused ion beam milling KALLOL DAS, HARLEY JOHNSON, JONATHAN FREUND, University of Illinois at Urbana-Champaign — Focused ion beams (FIB) offer an attractive tool for nanometer-scale manufacturing and material processing, particularly because they can be focused to a few nanometer diameter spot. This motivates their use for many applications, such as sample preparation for transmission electron microscopy (TEM), forming nanometer scale pores in thin films for DNA sequencing. Despite its widespread use, the specific mechanisms of FIB milling, especially at high ion fluxes for which significant phase change might occur, remains incompletely understood. Here we investigate the process of nanopore fabrication in thin Si films using molecular dynamics simulation where Ga^+ ions are used as the focused ions. For a range of ion intensities in a realistic configuration, a recirculating melt region develops, which is seen to flow with a symmetrical pattern, counter to how it would flow were it is driven by the ion momentum flux. Such flow is potentially important for the shape and composition of the formed structures. Relevant stress scales and estimated physical properties of silicon under these extreme conditions support the importance thermocapillary effects. A continuum flow model with Marangoni forcing reproduces the flow.

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