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Nanocrystalline Domain Formation as a Strain Relaxation Mechanism in Ultra-Thin Metallic Films M. RAUF GUNGOR, DIMITRIOS MAROUDAS, University of Massachusetts, Amherst — In this presentation, we report results for the atomistic mechanisms of strain relaxation over a wide range of applied biaxial tensile strain (up to 17%) in free standing Cu thin films based on isothermal-isostrain molecular-dynamics simulations. After an elastic response at low strain ($< 2\%$), plastic deformation occurs through ductile void growth accompanied by emission of screw dislocations from the void surface, as well as emission of threading dislocation loops from the film's surface. At strain levels below 8%, expansion of the plastic zone around the void during void growth is the major strain relaxation mechanism. At higher levels of applied strain ($> 8\%$), a practically uniform distribution of dislocations is generated in the metallic thin film, which mediates the transformation of the initially single-crystalline film structure to a nanocrystalline one. Furthermore, void growth is inhibited as the dislocations emitted from the void surface are pinned by the simultaneously generated network of defects in the nanocrystalline material.

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