Effective Use of Focused Ion Beam (FIB) and E-beam lithography in Investigating Fundamental Mechanical Properties of Materials at the Nano-Scale.

Julia R. Greer, Dongchan Jang, Ju-Young Kim, and Michael Burek

Abstract

Recent advances in the 2-beam focused ion beams technology has enabled researchers to not only perform high-precision nanolithography and micro-machining, but also to apply these novel fabrication techniques to investigating a broad range of materials' properties at the sub-micron and nano-scales. In our work, the FIB is utilized in manufacturing of sub-micron cylinders, or nano-pillars, as well as of TEM cross-sections to directly investigate mechanical properties of materials at these small length scales. Vertical nano-pillars, ranging in diameter between 100 nm and ~ 1 micron were fabricated from bulk single crystals, nanocrystalline materials, and amorphous metallic glasses and subsequently subjected to in-situ mechanical deformation in a one-of-a-kind instrument called SEMentor, combining the strengths of SEM and Nanoindenter. All samples show significant size effects and unique evolved microstructure. Post-mortem microstructure is investigated by utilizing the Omniprobe micromanipulator, coupled with FIB-milling and Pt deposition, for fabrication of site-specific TEM specimens.

Keywords: Focused Ion Beam (FIB); Nanoscale; Micromachining; TEM; Plasticity.

.