SEMINAR SERIES

Fundamental study of materials behavior under different loading conditions at nanoscale using advanced in situ and ex situ transmission electron microscopy techniques

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Behnam Aminahmadi received his B.S. degree Sahand University of Technology, Iran in 2007, his M.S. degree from Sharif University of Technology, Iran in 2009, and his Ph.D. degree from the University of Antwerp, Belgium in 2015. His research interests include characterization of materials using advanced electron microscopy techniques, plasticity and failure mechanisms of materials using in-situ nanomechanical tests in TEM, fundamental understanding of defect generation in different alloy systems, martensitic phase transformation in shape memory alloys and characterization of additive manufactured materials. His studies have led to the publication of more than 25 scientific papers in high impact factor peer reviewed journals. He is the recipient of BSSM Young Stress Analyst (YSA) and Graduate Excellence in Materials Science (GEMS) awards.

The first part of presentation will focus on advancements in transmission electron microscopy (TEM) techniques for in situ and ex situ nanomechanical experiments. First, in situ TEM tensile deformation of Ti-Mo alloy using Hysitron picoindenter holder will be discussed. Then, in situ high resolution TEM relaxation experiments of electron-beam evaporated Pd films using a novel on-chip tensile testing method will be presented. Specific attention will be paid to the characterization of dislocations and twin boundaries at different time intervals. Then, the effect of hydriding/dehydriding on plasticity mechanisms and formation of stacking faults in Pd films will be presented.

In the second part, microstructure investigations of NiTiHf shape memory alloys will be presented. The change in transformation temperature and critical martensitic transformation stress with different heat treatments has been examined using high resolution TEM. Specifically, strain fields about precipitates were measured using geometrical phase analysis (GPA) technique. Strains up to 2.5% were detected at distances up to 12 nm away from the precipitate–matrix interfaces. These strain fields favor martensitic transformation through the Clausius-Clapeyron relationship that governs the phase transformation. However, after over-aging, most of the precipitates lost their coherency. The strain fields around them were relaxed by misfit dislocations, and transformation temperatures decreased as a direct consequence of the strain relaxation.

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