Studying Phase Transformations and Twinning in Metals with Dark-Field X-ray Microscopy

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Twinning and martensitic phase transformations are the enabling mechanisms behind a diversity of mechanical and functional behaviors in metals, such as ferroelasticity, ferromagnetism, damping, superelasticity, shape memory, toughening, ductility, and hardening. In situ dark-field X-ray microscopy (DFXM) is uniquely suited for studying twinning and martensitic phase transformations, because it offers a spatial resolution sufficient for measuring the local strains surrounding the nucleation and growth of these important mechanisms under the surface of bulk samples. In the first part of this talk, I present results on martensitic phase transformation in NiTi shape memory alloys during in situ thermal cycling, and I discuss future opportunities for studying twinning and martensitic phase transformations with DFXM. In the second part of this talk, I present new results on recrystallization in Mg alloys, which I use as a demonstration of what we can get from combining multiple capabilities in a single experiment.