SEMINAIRE DE LA MATIERE CONDENSEE

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Beyond Slip : Using Neutron Diffraction and Polycrystalline Plasticity Models to Understand Plastic Deformation in Anisotropic Materials.

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Salle de conférence 15 – Bâtiment 563

Neutron and Synchrotron X-Ray diffraction yield information concerning the evolution of crystallographic texture, the internal stresses, and the microstructure in polycrystalline materials. This information can, in turn, be used to understand and characterize the micromechanics of plastic deformation of polycrystalline materials. Plastic deformation of cubic metals is relatively simple due to the high crystallographic symmetry of the underlying structure. Typically, one unique slip mode can provide arbitrary deformation. This is not true in lower symmetry hexagonal metals, for instance, where prismatic and basal slip (the usual favored modes) are insufficient to provide arbitrary deformation. Often, through control of the crystallographic texture, non-slip deformation modes, such as deformation twinning may be activated. Moreover, because the kinetics of dislocations and twinning are very different, the balance between the disparate deformation mechanisms can be controlled with strain rate and temperature resulting in novel mechanical properties that may be exploited.

This talk highlights studies undertaken by several researchers at the Los Alamos Neutron Scattering CEnter (LANSCE) over the past several years focused on the combined use of neutron and x-ray diffraction measurements and polycrystalline plasticity models to better understand these atypical deformation mechanisms. Beryllium will be used repeated as an example material to both demonstrate the power of coupled diffraction measurements and polycrystalline models, as well as to shed light on the plastic deformation of a truly enigmatic metal. The results are readily generalized to other hexagonal metals such as magnesium and zirconium, which perhaps have more industrial relevance.

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