School of Nano Science

School of PHYSICS

IPM Condensed Matter & Statistical Physics Group

Weekly Seminar

Micromechanics of Metals; (a) Crystal Plasticity through Dislocation Dynamics Simulation (b) Recoverable Plasticity in Penta-twinned Nanowires

Invited Speaker:

Amin Aghaei

Department of Mechanical Engineering, Stanford University, CA USA

Abstract

Plastic deformation in crystalline metals are the consequences of line defects known as dislocations. In fact, the nucleation, movement and interaction of these dislocation lines are responsible for plasticity. In the first part of this talk, the fundamentals of dislocation dynamics (DD) method is first described. DD is a modeling approach for the study of crystal plasticity wherein individual dislocation lines are discretized and their motion in the crystal is simulated. In order for DD simulations to provide insight into the strain hardening process, they must be able to reach plastic strains on the order of experimental values (>10%). Despite the development of massively parallel algorithms and codes, this level of plastic strain has been out of reach thus far. In this talk I will explain the newly developed advanced time-integration scheme which results in substantial speed-up enabling to gain much higher strains.

In the second part of the presentation, the experimental and molecular dynamics study of Bauschinger effect and recoverable plasticity in penta-twinned nanowires is presented. We observe the Bauschinger effect, that is, asymmetric plastic flow, and partial recovery of the plastic deformation upon unloading. TEM observations and atomistic simulations reveal that these processes occur due to the penta-twinned structure and emerge from reversible dislocation activity. While the incipient plastic mechanism through the nucleation of stacking fault decahedrons (SFDs) is fully reversible, plasticity becomes only partially reversible as intersecting SFDs lead to dislocation reactions and entanglements.

Wednesday, 30 Tir 95 (20 July, 2016), 2-3 pm

Farmaniyeh seminar room