Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Webinar

A statistical mechanical theory for the origin of rigidity in crystalline solids

Surajit Sengupta

TIFR - Hyderabad

When a crystal is slowly deformed, it encounters an unusual phase transition at infinitesimal deformation. Lattice translation symmetry is spontaneously broken and stress is released by lattice slip. Combining analytic calculations and computer simulations, we show that this transition may be viewed as a condensation of a specific linear combination of elastic displacements viz. a non-affine mode. Auxiliary fields, necessary to render the free energy density lattice translation invariant, give rise to interfacial dislocations that expel stress from the bulk. The total dislocation Burgers vector is constrained by the shape of the crystal. This determines the nature of the ground state where non-affine displacements are large near the slip plane but zero elsewhere. The interfacial energy of a critical droplet is independent of deformation to leading order.

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4:00 PM