

My main interest is in the mechanical behavior of materials: metals, ceramics and polymers. We study the dislocation patterning in metals during large plastic deformations by transmission electron microscopy. We study plastic forming operations of metals at high strain rates. We study the activity of slip system in the vicinity of small fatigue cracks. We are also interested in the initiation of fatigue cracks from surface defects. We try to understand the enhanced susceptibility to stress corrosion cracking of high strength steels.

The evolution of microstructure in dual-phase materials is affected by the elastic energy that arises from the difference between the lattice structures of the phases. Various systems exhibit elastic energy effects on the shape, orientation, arrangement and order of the second phase particles. Examples that I study are ordering of precipitates in nickel-base alloys, stresses generated in the multivariant structure of particles formed in martensitic phase transformation in bulk alloys, the shape, size and preferred sites for hydride nucleation on free surfaces and the ordering of quantum dots on the free surface of anisotropic crystals. Currently we are developing a set up for resonance ultrasonic spectroscopy to measure the elastic constants of anisotropic materials.

I am involved in several aspects of solar energy production for water desalination and electric energy conversion. My main effort is in the development of tungsten-based alloy for application as solar energy collectors. This alloy should be resistant to oxidation in air at high temperatures and have sufficient mechanical properties. Development of a new alloy involves many aspects of material thermodynamics, kinetics and mechanical behavior.

New scopes of properties of materials are recently revealed due to existence of structures that are particular to particles that are nanometric in size. I am interested in the thermodynamics of these new states, both in the theoretical and experimental aspects. We study changes in phase diagrams of nano-sized particles relative to conventional micrometric binary phase diagrams in metallic system. Currently we explore changes in the phase relations in binary diagrams of oxide alloys, which exhibit various particular phenomena including enhanced solubility and enhanced range of existence of certain phases on the expense of other phases.