THERMODYNAMICS OF MATERIALS UNDERGOING DISSIPATIVE PROCESSES

K. R. Rajagopal
Texas A&M University College Station, Tx-77845 e-mail:
krajagopal@tamu.edu

Abstract

In this talk, a general thermodynamic approach will be presented for modeling a class of material responses that has as its basis the notion that during a process that the material is subject to, the "natural configuration" from which the response of the body is described can change: the evolution of the "natural configurations" being determined by a certain thermodynamic criterion.

The body can also have different material symmetries with regard to these different natural configurations and this allows one to model processes during which the symmetry of the body changes. We consider bodies that can be described by a family of non-dissipative responses characterized by stored energy functions parameterized from an evolving set of "natural configurations". The evolution of the "natural configurations" is accompanied by dissipation and entropy production. The way in which the natural configurations change is determined by the maximization of "entropy production". By choosing different forms for the stored energy, rate of dissipation, etc., we can capture different types of dissipative responses as that evidenced in: classical plasticity, twinning, solid to solid phase transition, deformation of multi-network polymers, response of viscoelastic bodies, crystallization in polymers, flows of liquid crystals, the response of geological materials, growth and adaptation of biological materials, etc. The body possessing different natural configurations leads naturally to ideas introduced by Eshelby concerning configurational forces. The thermodynamic setting also provides a natural setting for generalizing the reciprocal relations due to Onsager.