

Abstract IUTAM

"Chemo-magneto-elastic couplings - experiments, modeling and structural instabilities"

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Our times is characterized by an increasing use of electromagnetic actuators in extremely large application domains, from largest to smallest scales. Miniaturization of systems adds new design constraints and requires the development of materials with controlled properties and of robust modeling of their behavior, especially when a multiphysic coupling is involved. Material solutions are numerous: magnetostrictive materials (MS), magnetic shape memory alloys (MSMA), piezoelectric materials, composite materials ... We will focus in this talk on magnetic materials exhibiting coupled chemo-magneto-mechanical behavior (MS, SMA and MSMA). We begin with a presentation of experimental results obtained in the laboratory illustrating the wide variety of phenomena associated with magneto-mechanical and chemo-mechanical coupling. We then give the principles of a unified multiscale modeling using a homogenization method and a stochastic approach as a basis of the constitutive law. The implementation in a finite element code will be briefly mentioned. We show that the behavior of MSMA can lead to localization phenomena given the inherent thermal phenomena in the first order transformation they may experience and the resulting softening. The numerical restitution of these localizations requires introducing the constitutive law of the homogeneous medium and a germination threshold in a finite difference code. We illustrate in particular the influence of loading rate on the number of localization bands.