2012 Special Program in Applied Mathematics and Applied Mechanics

Magnetoelectricity of multiferroic composites

2012 - 05 - 16 (Wed.)
14:00 - 16:00
308, Mathematics Research Center Building (ori. New Math. Bldg.)

Magnetoelectric (ME) coupling is of interest of a variety of applications, but is weak in natural materials. Strain-coupled composites of piezoelectric and piezomagnetic materials are an attractive way of obtaining enhanced effective magnetoelectricity. In this talk, we propose two ideas to increase the coupling further by rotating the poling direction/magnetic axis of the constituents or by making core/shell/matrix, three-phase multiferroic composites. For the former, we propose a method to optimize the effective ME voltage coefficient of fibrous composites made of piezoelectric and piezomagnetic phases. The optimization of magneotelectricity is with respect to the crystallographic orientations and the volume fraction for the two materials. We show that the effective in-plane and out-of-plane coupling constants can be enhanced many-fold at the optimal orientation compared to those at normal orientation. For the latter, we propose a micromechanical model to investigate the effective ME coupling coefficient of the three-phase coated particulate composite. Based on this model, we find the optimal volume fractions of the inclusion, the ratio of the radii between the core and shell for maximum ME coupling. Further, we correlate the ME effect with the material parameters of the constituent phases and propose useful engineering guide to the development of new ME coated particulate composites.