Carnegie Mellon
Materials Science and Engineering Seminar Series

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"A Relation Between Compatibility and Hysteresis and Its Role in the Search for New Active Materials"

Friday, October 29, 2010
10AM Seminar in Baker Hall 136A

We present some recent measurements of hysteresis, in materials undergoing big first order phase transformations, that resulted from a systematic program of tuning of the lattice parameters by changing composition. The lattice parameters were tuned so that a certain non generic condition of compatibility between phases was satisfied. A sharp drop of size of the thermal hysteresis occurred at the special lattice parameters. The data has some fascinating features, including an apparent singularity. We re-examine the origins of hysteresis in light of these measurements, and we conclude that a certain energy barrier, not pinning or thermal activation, is primarily responsible for hysteresis in martensitic phase transformations. We combine this kind of tuning, together with the lattice parameter sensitivity of electromagnetic properties, to find some interesting new multiferroic materials.

Richard D. James is Distinguished McKnight University Professor and Russell J. Penrose Professor at the University of Minnesota. He has a Sc.B. in Engineering from Brown University and a Ph.D. in Mechanical Engineering from the Johns Hopkins University. He was a member of the Institute for Advanced Study (1993-4), Rothschild Visiting Professor (Cambridge, 1999), and has held the Mary Shepard B. Upson Chair (Cornell, 2002), the John von Neumann Professorship (TU Munich, 2006) and the Copernicus Chair (Ferrara, 2010). He has authored or co-authored some 100 articles, has given 40 plenary and named lectureships, and was awarded the Humboldt Senior Research Award (2006/7), the Warner T. Koiter Medal from ASME (2008), the William Prager Medal from the Society of Engineering Science, and the Brown Engineering Alumni Medal (2009) for his research. Presently he works on two subjects: 1) martensitic phase transformations and multiferroic materials, 2) a new way to think about the structure of matter termed "objective structures".