Fundamental magnetocaloric studies of complex magnetic oxide systems

Paula Lampen

Functional Materials Laboratory
Physics Department, University of South Florida
Tampa, FL USA

Transition metal oxides (TMO) have long been a central focus of research in the condensed matter physics community as they provide a framework for the study of the complex relationships between structural, electronic and magnetic degrees of freedom. Competition among phonon, magnon, electron and spin interactions in these materials is associated with a near degeneracy of competing ground states and diverse phases that can be tuned with magnetic field, electric field, and chemical doping. As a result, large responses to small perturbations are manifested in such effects as colossal magnetoresistance (CMR), giant magnetoelectric (GME), and giant magnetocaloric (GMC) effects. While a complete understanding of the underlying magnetic ground state properties and cooperative phenomena in this class of compounds is key to manipulating their functionality for applications, it remains challenging problem to address experimentally. Recently, we have introduced a growing body of work demonstrating that the magnetocaloric studies are well-suited to this purpose, as they allow detailed investigations of the temperature and magnetic field response of various phases.

In this talk I present an overview of our recent results on the application of magnetocaloric measurements as a tool to study order-order magnetic transitions, phase coexistence, and the dependence of the nature of a magnetic transition on external parameters including chemical composition and particle diameter. The magnetocaloric properties of several representative manganite systems are discussed in detail, and a new phase diagram for the spin-chain cobaltite $Ca_3Co_2O_6$ is constructed based on the field and temperature evolution of the magnetic entropy change.