Dynamic heat capacity of perovskite manganites: calorimetric evidence for a first order transition and its implication to the magnetocaloric effect

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Finding a solid material with a large value of the magnetocaloric effect near room temperature is of exceeding importance, since this would lead to the development of more compact and environmentally safer cooling systems. Recently, manganites become the focus of attention due to its large magnetocaloric effect [1]. We demonstrate, via dynamic calorimetric measurements, that the large magnetocaloric effect in perovskite manganites stems from the first-order nature of the magnetic transition. Our results offer a clue in search for ideal magnetocaloric materials working in the vicinity of room temperature.

We constructed an adiabatic calorimeter [2] and newly developed a Peltier dynamic calorimeter [3], which allow the measurements of static and dynamic heat capacity of a solid, respectively. Using these calorimeters, we measured static and dynamic heat capacity of polycrystalline $La_{1-x}A_xMnO_3$ samples (with x of about 0.3 and A = Ca, Sr, and Ba), which display a drastic change in the Curie temperature T_c depending on the radius of A-site cations [4]. In particular, the system of A = Ca shows an extremely large heat capacity peak near T_c, and an associated large magnetocaloric effect. We demonstrate, from the dynamic heat capacity measurements, that this is due to the thermodynamic coexistence of two phases in the transition region.

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