Caloric Materials: a Playground for Fundamental Research and Novel Applications

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Abstract:
Scientists have long been fascinated by the observation the temperature of a material may change when an external stimulus is applied adiabatically. One of the earliest examples was the work of Gough [1] and Joule [2], who described the heating of natural rubber when stretched. A century later, magnetic refrigeration at milliKelvin temperatures was enabled by the discovery of magnetocaloric effects in paramagnets by Giauque, leading to the award of the Nobel Prize in Chemistry in 1949. What do these, and other, "caloric" materials discoveries have in common and how might they be of use in environmentally-friendly future technologies? In this talk, I will outline the basic thermodynamics that underpins caloric materials, and I will describe how the search for sharp phase transitions in solid refrigerants operating around room temperature [4] is leading to new potential applications of caloric materials to spintronics and to medicine.
[1] J. Gough, *Memoirs of the Literary and Philosophical Society of Manchester* **1,** 288-295 (1805).
[2] J.P. Joule, *Philosophical Transactions of the Royal Society of London* **149,** 91-131 (1859).
[3] W. F. Giauque, D. P. MacDougall, *Physical Review* **43**, 768 (1933).
[4] I. Takeuchi and K.G. Sandeman, *Physics Today* **68,** 48-54 (2015).