MIP: PARADIM at Cornell University, DMR-2039380
External User Project - 2024

Intertwined Phases and Magnetocaloric Anisotropy in $Cr_{2+x}Te_4$

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The discovery of intrinsic magnetism in atomically thin sheets of chromium iodine (CrI_3) fuels the search for related layered materials, to gain a better understanding in the emergence of magnetic properties and to find new candidates for future applications ranging from sensors and data storage to refrigeration.

Here, **users of PARADIM explored the rich phase space of chromium and tellurium** (Cr, Te). The $CrTe_2$ endmember is a layered dichalcogenide, with a series of interstitially ordered Cr rich phases, $Cr_{2+x}Te_4$. Using PARADIM's capabilities in single crystal growth, the group realized $CrTe_2$, $Cr_{1.27}Te_2$, Cr_2Te_3, and Cr_3Te_4 and subsequently characterized the materials properties, reported across several works.

Cr_2Te_3 is found to have a large, and highly anisotropic magnetocaloric effect at its magnetic phase transition temperature of T = 170 K. Since it is known that the magnetic ordering temperature increases to T = 280 K in the thin film limit, the PARADIM users conclude that Cr_2Te_3, with further chemical tuning, holds great promise as a thin film, room temperature, magnetocaloric for integration into electronic and solid-state devices.

A. Goswami, *et al.* *Phys. Rev. B* **109**, 054413 (2024).
A. Goswami, *et al.* *ACS Appl. Electron. Mater.* **6**, 4043–4056 (2024).
A. Goswami, *et al.* *J. Chem. Phys.* **160**, 214704 (2024).
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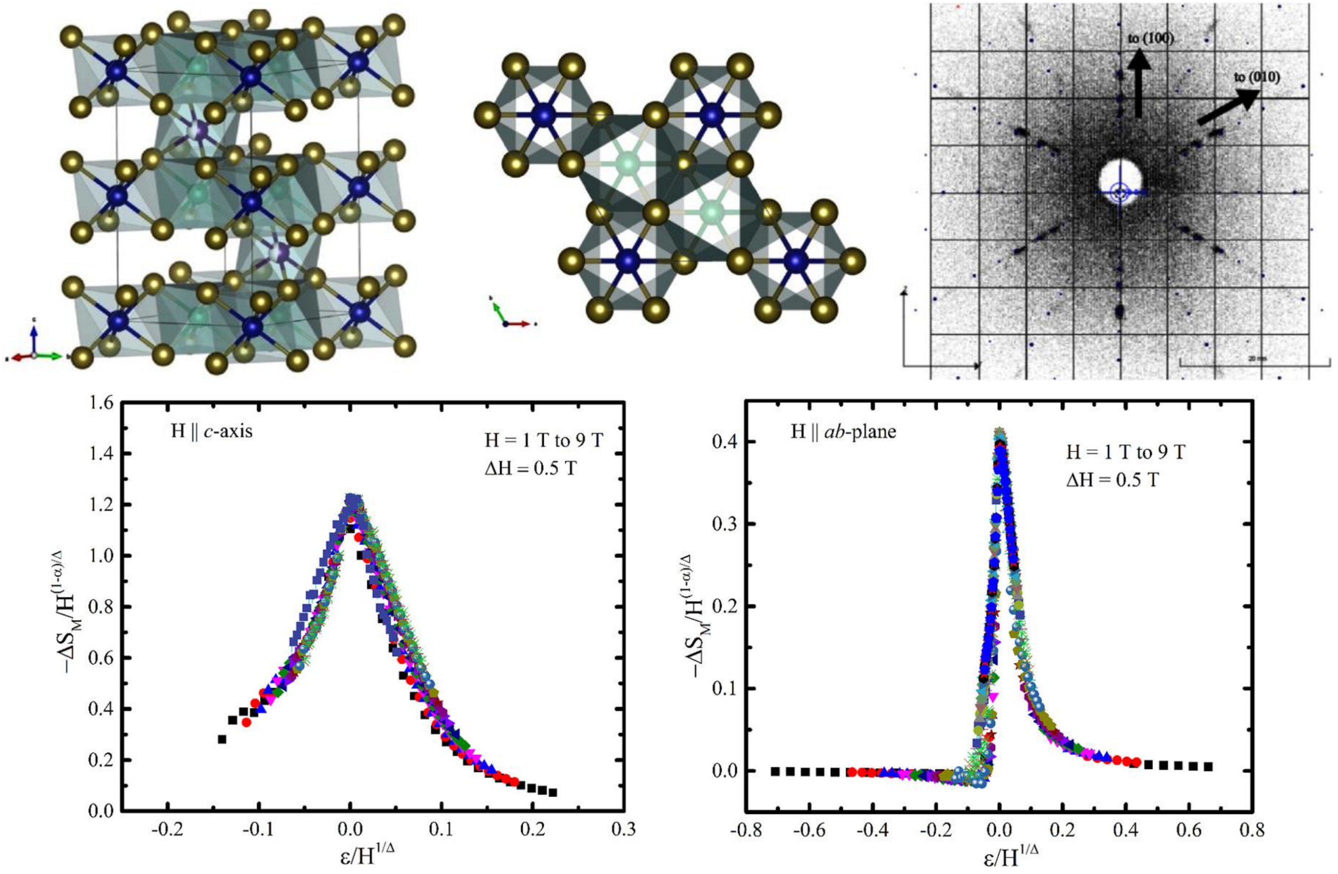

Figure: (Top) Three-dimensional and polyhedral views of the refined crystallographic unit cell and Laue diffraction image of the single-crystal Cr_2Te_3 sample. (bottom) Scaling of change of magnetic entropy curves: $-\Delta S_M/H^{(1-\alpha)/\Delta}$ vs $\varepsilon/H^{1/\Delta}$ along the (a) *c*-axis and (b) *ab*-plane.