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(I) Understanding the role of entropy in disordered crystalline materials

Tuesday, 7 June 2022 13:15 (30 minutes)

High entropy oxides (HEOs) are a new class of disordered materials that exhibit great promise for a range of applications due to their enhanced structural stability. The "entropy"in an HEO originates from the random mixture of five or more metal ions sharing a single crystal lattice. These phases can only form at high temperatures, when configurational entropy can overwhelm the enthalpy of formation for a conventional ordered phase. However, the actual degree of configurational disorder, its role in stabilizing the HEO phase, and its effect on other physical properties such as magnetism all remain open questions. To shed light on these questions, we have selected the spinel HEO (Mn,Fe,Cr,Co,Ni)3O4 as our model system. This material possesses two unique advantages over other HEOs: (i) the spinel structure has two distinct metal sites in its lattice, allowing us to directly probe entropic forces vs. site selectivity and (ii) all five metal ions are magnetic, meaning that we can independently study the effect of disorder and magnetic dilution. Our study makes use of experimental probes with sensitivities that extend over many orders of magnitude in length scale, which is important for characterizing the true degree of randomness. In my talk, I will present our findings on the nature of the role of entropy in determining the structure of the spinel HEO and the relationship between configurational disorder and magnetism.

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