Magnetism and chirality in complex osmates

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The structural chemistry of osmium oxides is currently underexplored and investigations in this area are ideal for finding new crystal structures and, due to the strong spin-orbit coupling hosted by osmium, intriguing physical properties. I will outline the results of two such investigations of osmate materials in this presentation.

The first is the synthesis of a new layered osmate with structurally discrete octahedra, $La_7Os_3O_{19}$, which presents an unusual magnetic phase diagram. Susceptibility data show that magnetic ordering, apparently antiferromagnetic, onsets at $T_N = 43$ K yet another broader anomaly exists near 14 K, with which the bulk of the magnetic entropy is associated. Between our lowest temperature of 2 K and well above T_N we find only approximately half of the expected magnetic entropy to be released. The magnetic phase diagram, as investigated by heat capacity and magnetisation includes a hysteretic metamagnetic transition [1]. We have used powder neutron diffraction to investigate the magnetic and nuclear structures of this material and shed light on the unconventional magnetic behaviour [2] and I will outline our results.

Our second investigation focuses on chirality in cubic osmates built from edge-sharing pairs of octahedra linked orthogonally into a three-dimensional network. Chiral responses coupling structural, thermal, electric and magnetic behaviours may be enhanced by strong spin-orbit coupling and this family of cubic chiral osmates provides an ideal system for study. Through high pressure powder neutron diffraction we have investigated the structural responses of chiral osmates in comparison to an achiral analogue with the aim of clarifying the link between chirality and compression pathways [3]. I will discuss our results and present an outlook to future developments in the area of structure-property relationships in osmates and related materials.

[1] A.T. Brennan, M.T. Pelly, A.S. Gibbs and A.W. Rost, Chem. Commun. (2026). 62, 3508-3511.
[2] A.T. Brennan, M. T. Pelly, E. Suard, A.W. Rost and A.S. Gibbs, to be submitted.
[3] A.T. Brennan, M. T. Pelly, K. McMahon, N. Funnell, C.L. Bull, H. Takagi, A.W. Rost and A.S. Gibbs, to be submitted.