

## Studies of Core-Levels Across a Defect-Induced Structural Transition in a Single Crystal of Magnetoelectric TbMnO<sub>3</sub>

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We report ongoing studies of x-ray photoemission and x-ray absorption spectroscopy, along with structural and thermal characterization of single crystals of magnetoelectric TbMnO<sub>3</sub> grown by us as part of our interest in the broader series of the magnetoelectric family RMnO<sub>3</sub> ( $R = \text{Dy, Y, Yb}$ ). The crystal was grown from a floating zone using a vertical two-mirror infrared image furnace. Using high temperature powder x-ray diffraction and thermo-gravimetric data, we have identified a structural phase transition at high temperatures, which we believe is driven by oxygen defect chemistry. Using another high temperature sample probe designed by us to interface with the Cylindrical Mirror Analyzer (CMA) chamber at the SRC, we have collected XPS data above and below the structural transition. Further experiments are needed in order to help understand the microscopic and structural origins of the changes we observe in x-ray photoemission.

Intrinsic magnetoelectrics are multiferroics which condense into a coupled ground state, simultaneously exhibiting magnetism and ferroelectricity. TbMnO<sub>3</sub>, a ferroelectric, is known to exhibit antiferromagnetism below 40K. We seek to understand the origin of magnetism in this system.

Single crystals of RMnO<sub>3</sub> were grown from stoichiometric polycrystalline rods in a gas mixture of 20% O<sub>2</sub> in Ar flowing at 1 atm. The crystal grew in the form of a rod of length ~6 cm, and diameter ~ 0.5cm. Pieces from this rod were cut and polished. High temperature (296K – 1350 K) XPS and XAS study of this single crystal was performed at SRC's HERMON beamline using a newly designed<sup>1</sup>, resistively-heated sample stage interfaced with the CMA chamber. We observed several changes at higher temperatures, most notably a split in the Tb 4f peak above 820K. High temperature powder x-ray diffraction, performed using a resistively heated Pt stage in Air, He and O<sub>2</sub> reveals a structural change to higher symmetry above ~850C, accompanied by change of total oxygen content. Further studies will be reported separately.

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<sup>1</sup> See M.S. Williamsen et al, SRC users' meeting abstracts October (2006).