Excitation Energy Dependence of Soft X-ray Emission of CrO_2 Thin Films

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Beamline(s): **X1B**

Introduction: Recently a high resolution study of the O *2p* soft x-ray absorption (SXA) spectrum has been made of thin films of CrO_2 (Stagarescu *et al*). Now, through the use of soft x-ray emission (SXE) spectroscopy, the O *2p* PDOS of the same thin films of CrO_2 has been measured and the excitation energy dependence of the O *2p* emission is under close consideration.

Methods and Materials: The high-intensity soft x-ray undulator beamline at X1B in combination with a specially designed soft x-ray emission spectrometer is ideally suited for soft x-ray photon in-photon out spectroscopies. SXE is an elementally specific probe which allows the local partial densities of states (LPDOS) of the valence band to be obtained. In this instance we apply SXE to the study of thin films of CrO_2. These single crystal thin films are grown on substrates of (100) TiO2, the resultant films were single phase with the *c* and *a*‖ axes being aligned to that of the substrate. Annealing results in a small cap layer (20Å) of Cr_2O_3. The CrO_2 films have thicknesses ranging from 4000Å to 520Å.

Results: The preliminary results are displayed in **Figure 1** with SXA and SXE spectra of a CrO_2 thin film and Cr2O3 powder for comparison. The marked contrast between the SXA (and SXE) of the CrO_2 film and the Cr_2O_3 powder appears to indicate that the contribution to the O signal from the small cap layer is negligible. Shown in **Figure 2** is the variation of the O *K* SXE spectra with the incident photon energy.

Conclusions: The O *2p* LPDOS of CrO2 has been measured by SXE and tends to agree with that which was calculated by Korotin *et al.* The excitation energy dependence of the O *2p* emission has also been studied. Measurement as well as interpretation of the results is still ongoing at this time.

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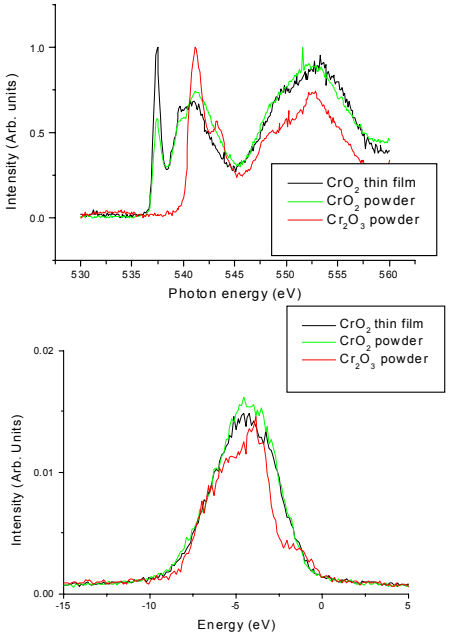

Figure 1. **Top:** The O *K* SXA spectrum of CrO_2 thin film and powder is compared with that obtained from Cr_2O_3. Note that the SXA spectrum of the CrO_2 thin film was taken with the plane of polarization at an angle approx 22 degrees from the *c* axis which is in the plane of the sample.
Bottom: Shown are the O K SXE spectra from a CrO_2 thin film, CrO_2 powder and Cr_2O_3 powder respectively. All three SXE spectra were acquired with the same excitation energy. The energy scale is with respect to the valence band maximum (VBM)

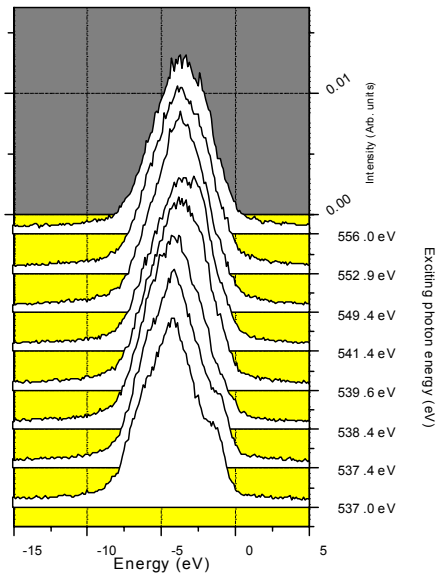

Figure 2. The excitation energy dependence of the O *2p* SXE spectra. The excitation energy corresponds to the energy shown on the scale in Figure 1 (top).