

ESRF

Experiment title: Orbital ordering search in LaMnO ₃ .	Experiment number: HE-479	
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Report:

The orbital degree of freedom in manganites plays an important role in determining the unique electronic properties of these materials. For LaMnO₃ compound, orthorhombic below 600 K approximately, the Mn atom is surrounded by six oxygen atoms in octahedral configuration. The octahedra present a large tetragonal Jahn-Teller distortion and the direction of this distortion alternates from manganese to manganese in the ab plane, giving rise to an effective ordering. Associated to this distortions ordering, an orbital ordering has been proposed.

We have investigated the orbital ordering in LaMnO₃ in the whole range of temperatures across the magnetic transition by means of X-Ray Anomalous Diffraction at the Mn K-edge. Single crystals of LaMnO₃ were grown by the floating-zone method with its axis parallel to cubic [010] and [001] directions. DAFS spectra of forbidden (030)_c and (050)_c reflections were recorded at different temperatures. The energy dependence of the intensity of both reflections near the Mn K-edge at RT is shown in Figure 1. There is a striking enhancement of the intensity at E=6.553 KeV, about 3 eV above the edge, which identifies this resonance with electric dipole transitions (1s → 4p) as it was reported by Murakami *et al.*(1), Phys. Rev. Lett. **81**, 582 (1998).

Polarization analysis also revealed a predominantly π' -polarized component as reported before (1). Anomalous scattering at the pre-edge feature were also measured in order to study quadrupolar transitions to the d-states, but no quadrupolar component was found. Besides, EXAFS oscillations were also observed.

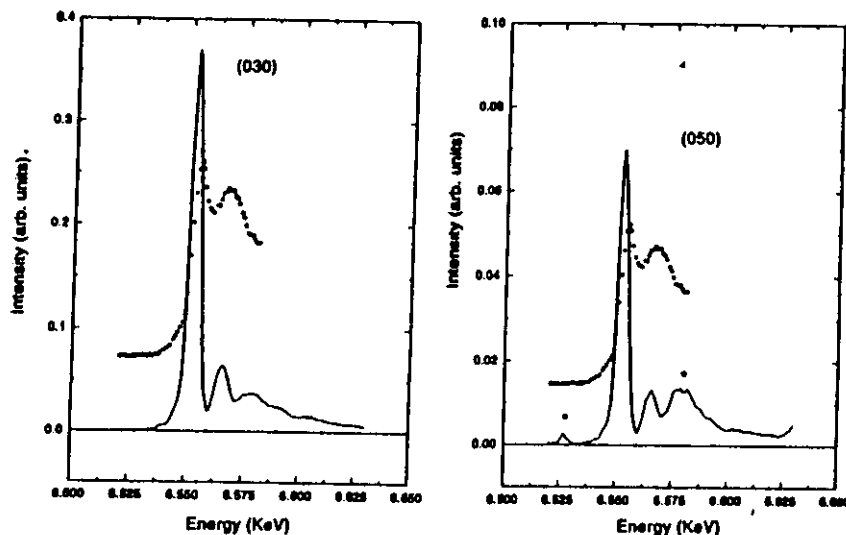


Figure 1. Energy dependence of the intensity of $(030)_c$ and $(050)_c$ reflections with π' polarization near the Mn K-absorption edge at RT. Closed circles represent the measured fluorescence. (*) indicates multiple diffraction peaks.

We have also investigated the anomalous scattering of the forbidden reflection $(003)_c$ related to the magnetic ordering. We have measured the reflection peak at energies below and at the Mn K-edge in the whole range of temperatures. In figure 2, it is shown the intensity of the $(003)_c$ reflection at $E=6.52$ KeV and $T=280$ K for both σ' and π' polarization. The intensity of the peak is nearly constant with temperature and polarization analysis revealed comparable σ' and π' components. A detailed analysis of this result is still in progress.

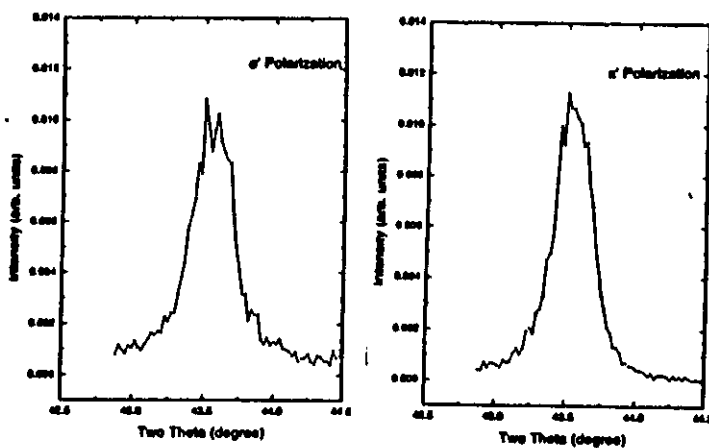


Figure 2. Intensity of $(003)_c$ reflection at $E=6.52$ KeV and $T=280$ K with σ' and π' polarization respectively.