ESRF	**Experiment title:** Soft X-ray resonant scattering study of the charge distribution in a stripe-ordered cuprate	**Experiment number**: HE-2083
Beamline: ID08	**Date of experiment**: from: 16 March 2006 to: 22 March 2006	**Date of report**: 28 August 2006
Shifts: 18	**Local contact(s)**: Dr Peter Bencock	*Received at ESRF:*

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Report:

This experiment was designed to probe the charge modulations associated with static stripe order in a copper oxide superconductor by the new technique of soft X-ray resonant scattering. The principle of the method is to use the large resonant enhancements in the X-ray scattering at the copper L and oxygen K absoption edges to obain direct information on charge segregation in the Cu 3d and O 2p orbitals.

A very high quality single crystal of $La_{1.6-x}Sr_xNd_{0.4}CuO_4$ with $x = 0.12$ was used for the experiment. This composition has previously been found to exhibit charge order below T_{CO}=65 K, and has a modulation wavevector of (2ε,0,0.5) with $\varepsilon = x = 0.12$. Separate measurements on ID20 with non-resonant X-rays (8.5 keV) confirmed the existence of charge order in the crystal. For example, the plots in Fig. 1 show diffraction from the structural distortions associated with the charge order. The peak width indicates that the charge order is correlated over a range of at least 200 Å, and the disappearence of the peak at $T \approx 65$ K is consistent with the charge ordering behaviour expected for this crystal composition.

Unfortunately, the experiment on ID08 was not successful. The reason for the failure was a leak in the ID08 UHV chamber. The existence of the leak was known before the experiment started but the ID08 staff were not sure whether it was sufficiently serious to prevent the experiment from being undertaken. During the experiment the vacuum could not be reduced below 2×10^{-7} mbar with the sample cold, well above the normal $\sim10^{-9}$ mbar base.

On warming the sample to room temperature the pressure was found to rise into the tens of mbar range indicating that the surface of the sample had become contaminated with what was presumed to be solid water and nitrogen. This diagnosis was confirmed by electron yield measurements at the oxygen K edge (which showed a feature that increased with time over a period of ~1 hour) and visual inspection of the sample which showed a dull surface layer. Various remedies were tried with help of the ID08 staff during the beam time to improve the vacuum but none were found to offer any improvement. Given the surface sensitivity of soft X-ray scattering on resonance it is our belief that this extreme surface contamination prevented us from measuring a diffraction signal.

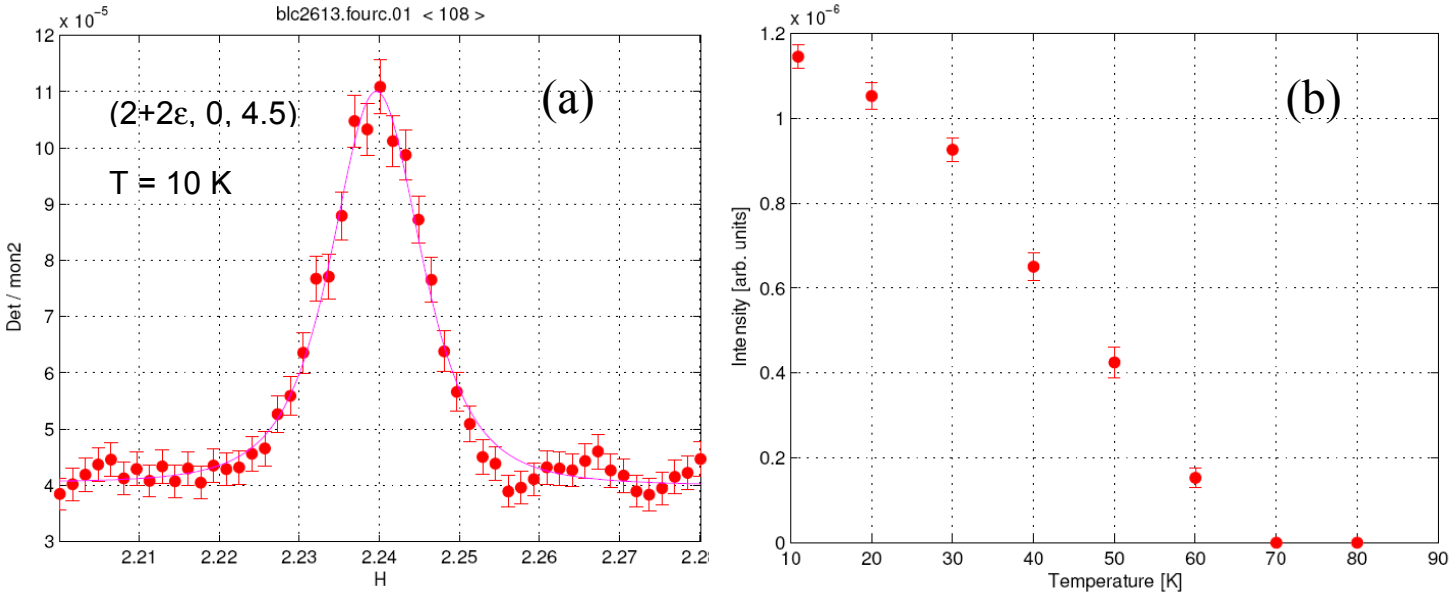

Fig. 1. X-ray diffraction from the structural distortion associated with stripe order in $La_{1.6-x}Sr_xNd_{0.4}CuO_4$ (x=0.12). (a) Scan parallel to (H, 0, 0) through the peak at (2+2ε, 0, 4.5). (b) Temperature dependence of the peak shown in (a).

The measurements were made on ID20 at an X-ray energy 8.5 keV. The counting time was 15 s per point.