MS26-P4 Staging superstructures in high-T_c Sr/O co-doped $La_{2-x}Sr_xCuO_{4+y}$

Pia J. Ray[1], Niels H. Andersen[2], Feng-Chen Chou[3], Thomas B.S. Jensen[2], Hashini E. Mohottala[4,5], Christof Niedermayer[6], Barret O. Wells[4], Martin von Zimmermann[7], Linda Udby[1]

1. Nano-Science Center, Niels Bohr Institute, University of Copenhagen, DK-2100 Copenhagen, Denmark
2. Physics Department, Technical University of Denmark, DK-2800 Kgs. Lyngby, Denmark
3. Center for Condensed Matter Sciences, National Taiwan University, Taipei 10617, Taiwan
4. Department of Physics, University of Connecticut U-3046,2152 Hillside Road, Storrs, Connecticut 06269-3046, USA
5. Department of Physics, University of Hartford, 200, Bloomfield Ave., West Hartford, CT-06117, USA
6. Laboratory for Neutron Scattering, ETHZ & PSI, Ch-5232 Villigen PSI, Switzerland
7. Deutsches Elektronen-Synchrotron, Notkestraße 85 D-22607 Hamburg, Germany

email: pjray@bozack.dk

The very rich cuprate phase diagram continues to induce new investigations for the mechanism behind high-T_c superconductivity in these materials. It is well known that the superconducting phase transition strongly depends on the hole content in the case of chemical substitution of La for Sr in $La_{2-x}Sr_xCuO_4$, as well as for intercalation of O in La_2CuO_{4+y}.

We will here present results of elastic hard X-ray scattering experiments on the Sr/O co-doped $La_{2-x}Sr_xCuO_{4+y}$ family of compounds, in particular with x=0.00, 0.04, 0.065, and 0.09. Co-doping by superoxygenating the Sr doped compound opens up for a vast space of new and surprising phases. In particular, these samples all have the same superconducting critical temperature T_c = 40 K independent of the Sr content, in contrast to oxygen-stoichiometric samples. We observe the superstructure known as staging - or hints of it - in all four samples. Staging is characterised by a number n referring to the periodicity of the intercalated oxygen layers in terms of CuO_6 spacings, and has only been investigated earlier in samples without Sr doping.

We find that the staging number n increases monotonically with Sr doping x despite the unchanged T_c. Furthermore, the transition temperature for the staging phase increases with x. This indicates a correlation between the randomly positioned Sr ions and the mobile oxygen interstitials, resulting in a stabilization of the staged phase with x, while the superconducting phase seemingly remains the same over varying x. This points to the interstitial oxygen that do not take part in the staging being responsible for the high-T_c superconductivity in the samples.

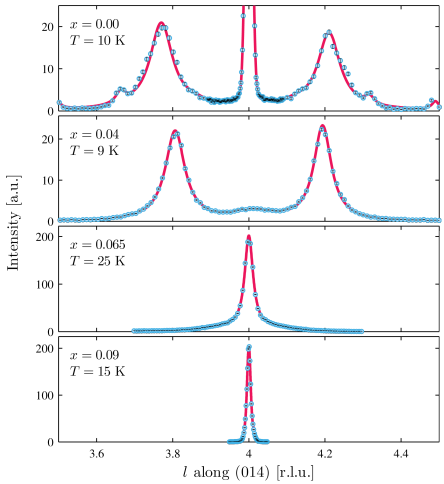

Figure 1. Examples of data fitted to several peak shapes in a single combined fit in order to obtain the reflection positions and intensities. Each set of peaks around the central (014) peak correspond to a staging related to the ordering of oxygen interstitials along the c axis.

Keywords: superconductivity, modulated crystal structure, staging, hard X-rays