ESRF	**Experiment title:** Study of local domains of the ordering photo-induced superstrudture and the disorder-order phase transitionat different temperature in La_2CuO_{4+y}	**Experiment number**: HS-2556
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Report:

We have performed a study of the effect of photon flux and temperature on the two superstructures, named q_2 and q_3, which coexist in the same La_2CuO_{4+y} single crystal. These superstructures are due to ordering of interstitial oxygen ions y and charge modulation in the active CuO2 plane. The aim of this study was to develop a novel method to manipulate and control structural inhomogeneities giving nanoscale phase separation on the atomic scale length, using high resolution X-ray diffraction imaging.

During the allocated beam-time we have measured the superstructures in an oxygenated La_2CuO_{4+y} single crystal with y=0.10, by high-resolution X-ray synchrotron diffraction. We have performed the measurements using a wavelength λ=0.9 Å and a micron size focused x-ray beam. First, we removed the ordered phase Q_2 by heating the sample at 380 K, where the interstitial oxygen ions are completely disordered but the interstitial oxygen content remains constant since oxygen do not escape out of the crystal. Second, we have illuminated with an intense and continuous x-ray flux along a line crossing the centre of the sample (having a size of about 1.5 mm), at T=270 K. Third, the sample has been rapidly quenched to 95K and we read the effect of the illumination doing a mapping of the oxygen ordered domain created by photo-illumination.

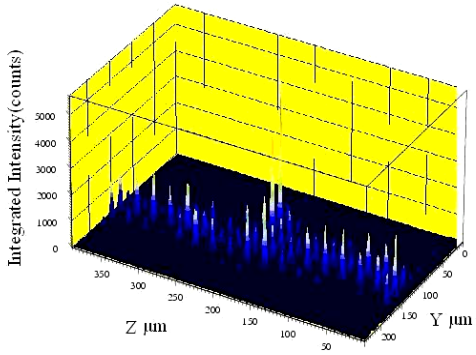

Fig 1: 3D Mapping in a region 400micron*20 micron q_2

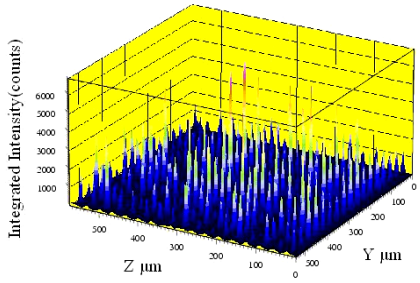

Fig 2: 3D Mapping of the intensity of the superstructure q_3 on the sample surface.

We observe that the intensity of the diffraction pattern q_2 due to ordered interstitial oxygen ions is distribuited only along the illuminated line as it can be observed in Fig. 1 while the charge ordering diffuse peak is randomly distributed over the sample surface as shown in Fig. 2.

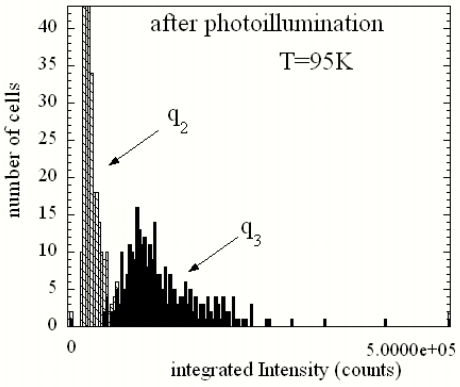

Fig. 3: Histogram of the intensity of q2 and q3

Figure 3 shows the distribution of the intensities of both superstructures. The diffuse short range x-ray pattern q3 shows a wide intensity distibution on the contrary the q2 peaks due to photoinduced x-ray oxygen ordering have a well defined intensity that is determined by the x-ray illumination dose. It is intersting to remark that the average intensity of q3 superstructure is larger than that due to oxygen ordering q2.

This work shows that it is so possibile to controll and manipulate locally x-ray illumination the phase separtion between domains with ordered and disordered interstitial oxygen ions.