ESRF	**Experiment title:** Nanoscale self-organization under X-ray illumination	**Experiment number**: HS-2556
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Report:

The aim of this experiment was to characterize distribution of the superstructures derived by ordering of the oxygen dopants, in a single crystal of La_2CuO_{4+y} (y~0.1), in micro domains exploiting spatial mapping using X-ray micro diffraction.

The application of X-ray micro diffraction is an ideal tool for the observation and manipulation of the mesoscopic hetereostructures in the metal oxides.

We have focused our attention on the oxygen doped $La_2CuO_{4+y,}$ it shows a competition between different ordering phases giving place to the coexistence of different oxygen domains in the same single crystal. Each interstitial oxygen ordered phase can be identified by its XRD superstructure. The characteristics of ID 13 are well suited for the experiment because it was possible to observe the weak superstructure spots, which were impossible to detect a conventional X-ray laboratory source. For this reason we need an high resolution and high flux to solve weak superstructure spots associated to possible ordering due to coexisting phases in this systems. Moreover it was possible to control the formation and the melting of these ordered nano-textured domains by using an intense polarized synchrotron radiation X-ray beam of 0.1 nm wavelength photons and of size 0.5 micron at room temperature.

During the allocated beam time we have done firstly a mesh of the all sample, after localizing the one of the two superstructures presented in this oxide cuprate at room temperature around the bragg peak (0,0,6). Secondly some mesh of micron region localized on the centre of a La_2CuO_{4+y} single crystal to study the spatial distribution of this superstructure. We have observed that the oxygen ordered domains are localized around the centre of the sample (Fig 1)

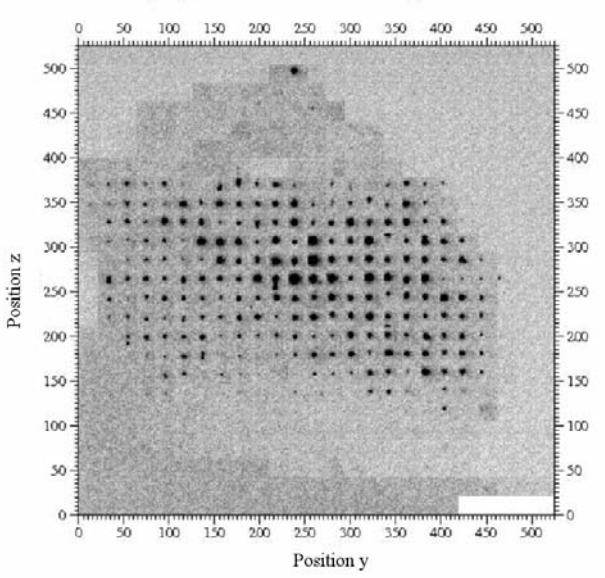

Fig 1: Mapping of the oxygen ordered domains in the as grown sample. The black dots shows the intensity of the q2 superstructure due to interstitial oxygen ordering in a as grown sample.

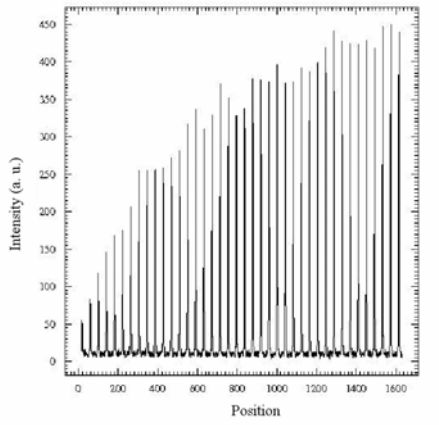

Fig.2: The increasing of the intensity along a region of the sample after the illumination.

In the second part of the experiment we have investigated the x-ray phtoinduced oxygen ordering due to X-ray illumination. As it is shown in Fig.2 we have observed the increase of the intensity of the q_2 line as a function of the dose of X-rays by keeping the sample under continous synchrotron rdiation illumination. In fact we have illuminated a region of about 10 micron and we have observed an increasing of the charge ordering in this region.

The results obtained in this experiment help us to solve the local spatial distribution of interstitial oxygen ions, and characterize the physical parameters to manipulate the local domain structures using high flux x-ray illumination. The outcome of the experiments is relevant to study locally the characteristic of the microscopic phase separation in these functional oxides.