ESRF	**Experiment title: Local phase slippage of sliding charge-density waves in vanadium and tungsten-doped blue bronzes $K_{0.3}MoO_3$.**	**Experiment number**: **HE-844**
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Report:

The purpose of the experiment was to study the structure of a sliding charge-density wave in the vicinity of a charged defect in vanadium-doped blue bronze. To achieve this goal, we planned to accurately measure the profile of $2k_F$-satellite reflections at low temperature while applying an electric field on the sample (k_F is the Fermi wave vector). In previous works, we had shown that a profile asymmetry of the satellite reflections was a direct evidence of the presence of Friedel oscillation around the defect [1]. Observation of a change in the profile asymmetry during the CDW sliding would give information on the phase slippage near the impurity, needed to make the CDW move.

A heavily doped crystal (~0.5*2.5*0.1 mm^3) with two electrical contacts was glued on a sample holder coated with capton and mounted vertically (i.e. b axis normal to the scattering plane) in a closed-cycle He refrigerator. The wave length was 0.887Å. Figure 1 displays the profile of the (13, 1.286, -6.5) reflection along the **b*** direction at T=18 K. The value of the wave vector along **b*** gives $2k_F$=0.714, which correspond to a V concentration of 1.44%, consistent with our preliminary experiments. The profile obtained is clearly asymmetric, as expected. We tried to apply a current but a strong irradiation effect was observed, decreasing the intensity of the peak scan after scan, as indicated in Figure 1. We also measured an additional current upon irradiation, that we interpreted as a photo-current. Clearly, no measurement were possible on this sample.

A less doped sample was then mounted, in exactly the same geometry. Irradiation damages were minimized by aligning the sample with a low x-ray flux and by irradiating the crystal on different zones of about 0.5 mm. Figure 2 shows low temperature (~18 K) k-scans of the satellite reflections (13 0.743 –6.5) and (13 1.287 –6.5). The value of the CDW reduced wave vector was found to be 0.743±0.005, corresponding to a V-concentration of 0.28%±0.01%. The resolution (Half-Width at Half-Maximum: HWHM) was measured on the (13 1 -6) neighboring Bragg reflection and found to be 0.004 $Å^{-1}$, 0.001 $Å^{-1}$ and 0.002 $Å^{-1}$ in the longitudinal **b***, and transverse 2**a***+**c*** and 2**a***-**c*** directions. The size of the correlated domains was measured from the HWHM of the satellite reflections, using a deconvolution procedure in the most resolved b* direction (see fig. 2 and 3). The size was found to be 150*65*13=126750 $Å^3$ (**b***, 2**a***+**c***, 2**a***-**c*** directions), which correspond to a slightly 3D-ordered domain, contrarily to the 1.44%-V crystal. From the 0.28%-V concentration we get 5 V-impurities per ordered domains. This corresponds to a situation intermediate between the strong pinning limit (where only 1 impurity per ordered domain is expected) and a weak pinning limit (where a large number of impurities per domain is expected). The profile asymmetry of the peak along the **b*** direction was also still clearly observed as shown in Fig. 2, though much weaker that for the 1.44%-V sample. The x-ray conditions were thus perfect to study the effect of the field.

Because the Peierls transition is strongly smeared out in this doped blue bronze, a sharp threshold signaling the CDW depinning was not expected, but rather the occurrence of a broad band noise. Previous measurements on a 0.28%-V sample had revealed this behavior. However the sample measured in this present experiment did not show any increase in the noise till the maximum voltage applied. DC measurements were only possible till a voltage across the sample of 2.5V, while uni-polar pulsed measurements have allowed the application of 12V (*i.e.* an electric field of 45 V/cm, three orders of magnitude larger than that for a pure blue bronze sample, but still less than the threshold for sliding) before an overheating of the sample.

In conclusion, this first experiment on blue bronze has shown the feasibility of the project. The diffraction conditions were perfect, though unexpected strong irradiation effects have been observed for the first time in this type of materials. The huge electric field needed for depinning the CDW requires the use of a less doped sample (with however a sizeable asymmetry of the satellite reflections) and improvement of the sample thermalisation.

[1] S. Rouzière, S. Ravy, J.-P. Pouget and S. Brazovskii, Phys. Rev. **62**, R16231 (2000).

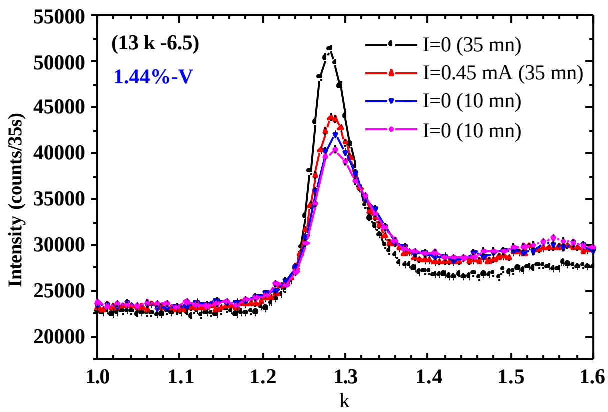

Figure 1 : Successive k-scans of the (13, 1.286, -6.5) scattering on the first 1.44%-V sample. Scan durations are indicated.

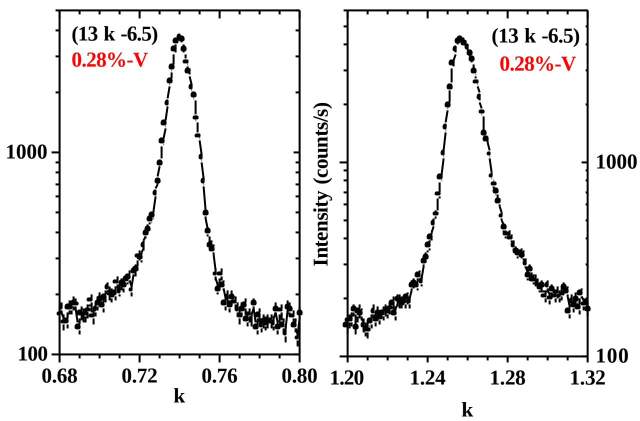

Figure 2 : k-scans of the (13 1.257 –6.5) (right) and (13 0.743 –6.5) (left) scattering in the 0.28%-V sample. Note the logarithmic scale on the intensity axis.

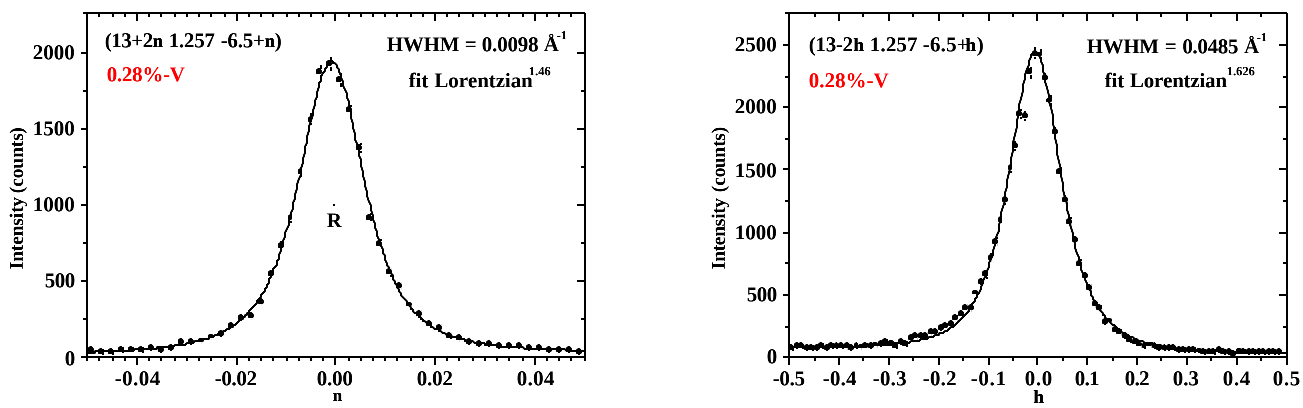

Figure 3 : Transverse scans of the (13 1.257 –6.5) scattering, in the in-plane 2**a***+**c*** direction (left) and inter plane 2**a***-**c*** directions (right) in the 0.28%-V sample. Best fit are indicated, along with Half-Width at Half-Maxima (HWHM).