ESRF	**Experiment title:** Surface Phase Transition in Pb/Cu(100)	**Experiment number**: 25-02/649
Beamline: BM25B	**Date of experiment**: from: 20/01/09 to: 26/01/09	**Date of report**: 26/02/09
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Report:

Group metals III and IV absorbed on (100) oriented noble metals exhibit a rich variety of surface structures. The goal of this experiment was to characterized the phase transition dynamic between the phases c(5√2x√2)R45^o and (√2x√2)R45^o split, that take place in Pb/Cu(100) at 0.6ML and at 450 K (see **table I**). Our aim was also to study the cristallography of the phases involved in this transition, which would let us relate the electronic changes to the structural ones. The role of the electronic structure on this reversible phase transition is not clear yet, so this study could give light to its understanding. For the (√2x√2)R45^o split we proposed the same atomic structure as for the (5x5)R tg^{-1}(3/4) phase, which comprises square domains of (√2x√2)R45^o separated by wall domains.

HT					(√2x√2)R45^o split "c(2x2)" split T=450 K
RT		(2√2x2√2)R45^o "c(4x4)"	√2x√2)R45^o "c(2x2)"	√2x√2)R45^o split **IIc** "c(2x2)" split	c(5√2x√2)R45^o
LT	√61x√61 R tan^{-1}(5/6)		(3√2x√2)R45^o	≈(5x5)R tg^{-1}(3/4)	
ML	0.24	3/8	1/2	0.5-0.6	6/10

Table I Phase diagram of Pb/Cu(100) in the monolayer regime (horizontal axis) as a function of temperature (vertical axis)

Results:

We obtained a good sample quality both in the clean and Pb-evaporated samples. The technical problems we had in the previous beamtime with the sample annealing are completely solved. We have succesfully

prepared the phase c(5√2x√2)R45º and characterized it by measuring three CTR's, five fraccional rods and in-planes alomg five directions. In **fig.1** we show a fraccional rod at (0.8 -0.2 L), with l=0.2-2.8.

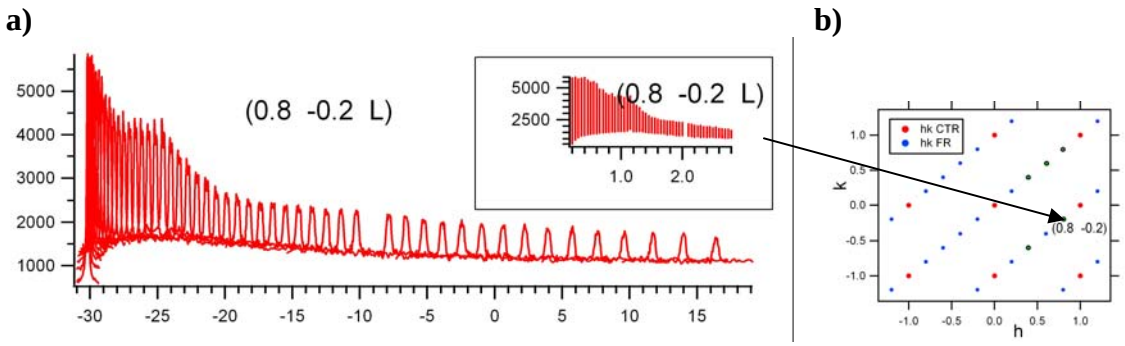

Fig.1a) Superposition of fractional rod spectra vs phi at (0.8 -0.2) for different l values. In the inset we plotted the same vs l;
b) (hk) diagram of the phase c(5√2x√2)R45º ; the measured fractional rods are highlighted in green.

The quality of the peaks reveals the formation of a good surface and the possibility of analyzing the surface crystallography of this phase.
Once characterized this phase, we started annealing the sample to reach the (√2x√2)R45º split phase. In **fig.2** we followed the spot (0.6 0.6 1.2) from the c(5√2x√2)R45º phase during the sample annealing until it disappeared.

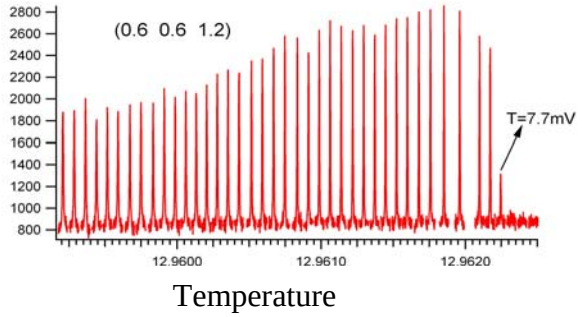

Fig.2 Intensity of the (0.6 0.6 1.2) spot from the c(5√2x√2)R45º phase vs the sample temperature.

We could not find the spots of the (√2x√2)R45º split phase by SXRD. Even though this phase should have shown a LEED pattern as pictured in **Fig.3b**, we could not check it due to technical problems. A closer inspection to previous LEED patterns of the (√2x√2)R45º split phase, as the one in **Fig.3b**, reveals that its background is prominent. We should evaluate the possibility that the domains of the (√2x√2)R45º split phase are not big enough to be studied by SXRD.

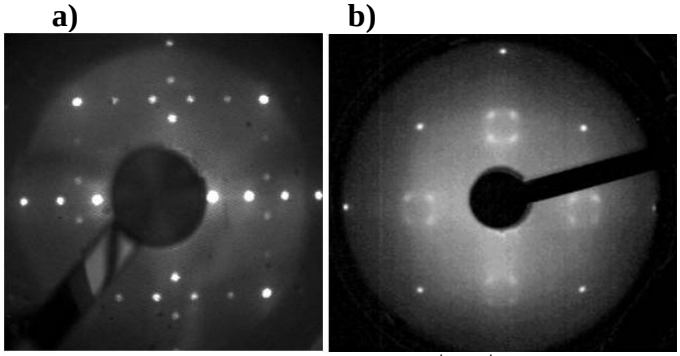

Fig.3 a) LEED pattern of the c(5√2x√2)R45º phase and **b)** of the(√2x√2)R45º split phase.

Conclusion:
The good performance of the diffractometer and the rest of the beamline let us got a complete data set to characterize the atomic structure of the c(5√2x√2)R45º phase. Further SXRD and complementary studies (STM) are needed to characterized the (√2x√2)R45º split phase.