ESRF	**Experiment title:** Adsorption of Phthalocyanine molecules on different metal surfaces	**Experiment number**: SI-2003
Beamline:	**Date of experiment**: from: 10.11. to: 17.11.2009	**Date of report**: 24.02.2011
Shifts:	**Local contact(s)**: Parasmani Rajput	*Received at ESRF:*

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Report:

Within the last ESRF beamtime projects we have investigated geometric and electronic properties of Metal-Phthalocyanine molecules adsorbed on Ag(111) in submonolayers (see reports on SI 1891, 1820, 1647 and 1529 as well as I. Kröger et al., New J. Phys. **12**, 083038 (2010), C. Stadler et al., Nature Physics **5**, 153 (2009), and C. Stadler et al., Phys. Rev. B **74**, 035404 (2006). Starting with project SI-1891 we began to investigate the adsorption of such molecules on Au and Cu (111) oriented surfaces.

Fundamental differences have been found for the interaction of CuPc on Cu, Ag and Au surfaces. On Au(111) a weak physisorption was found. Hence, the phase diagram is much simpler in the submonolayer regime. The molecules form incommensurate structures which are dominated by van der Waals interaction within the layer.

On Cu(111) the interaction across the interface is much stronger, the adsorption is more site specific and the molecules therefore are less mobile. The consequence is chain-like growth of molecules at very small coverages which changes to growth of island when more molecules adsorb at the surface. The chain formation can be understood in terms of a molecular quadrupole moment which is induced by the strong interaction with the substrate, see B. Stadtmüller et al., Phys. Rev. B **83**, 085416 (2011).

NIXSW experiments performed within this project contributed significantly to the conclusions drawn for this adsorbate family. Clear differences in the adsorption height could

be identified for the three substrates. Furthermore, it could be revealed that the adsorption height is also depending on coverage. In a more densely packed overlayer the molecule-substrate interaction weakens. This is in good agreement with the donation-backdonation model which was suggested as the fundamental mechanism for the intermolecular repulsion found for CuPc and SnPc on Ag(111) earlier.

Publications in context with this project:

- I. Kröger, B. Stadtmüller, C. Kleimann, Y. Mi, P. Rajput, J. Zegenhagen, C. Kumpf, *Normal incidence x-ray standing waves study on copper-phthalocyanine submonolayers on Cu(111) and Au(111)*, submitted to Phys. Rev. B.
- B. Stadtmüller, I. Kröger, F. Reinert, C. Kumpf, *Submonolayer growth of CuPc on noble metal surfaces*, Phys. Rev. B **83**, 085416 (2011).
- I. Kröger, B. Stadtmüller, C. Stadler, J. Ziroff, M. Kochler, A. Stahl, F. Pollinger, T.-L. Lee, J. Zegenhagen, F. Reinert, C. Kumpf, *Submonolayer growth of copper-phthalocyanine on Ag(111)*, New J. Phys. **12**, 083038 (2010).