MASTER DE PHYSIQUE ET APPLICATIONS - 2ème année
Spécialité Sciences des Matériaux et Nano-objets
International Nanomat Master Program

Internship proposal 2011-2012

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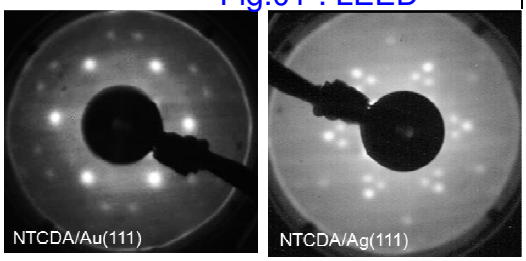
Probing electronic properties of well-ordered organic films on metal surfaces by ARPES and NEXAFS: NTCDA on (111)-oriented Ag and Au surfaces

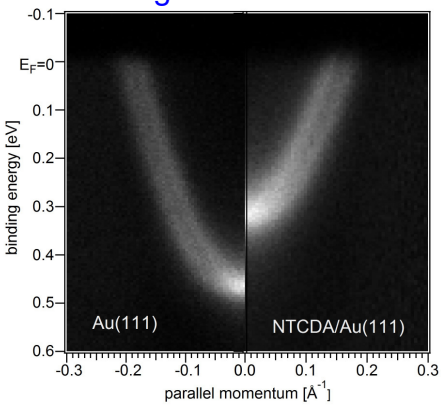
Scientific project :

Fig.01 : LEED



Interest in studying properties of functional organic molecules on metal surfaces has grown remarkably in the recent years. We propose here to study fundamental properties like the growth mode, molecule orientation, and charge transfer process at the interface of NTCDA molecules adsorbed on (111)-oriented Ag and Au surfaces. The experiments will be done at TEMPO beamline of synchrotron SOLEIL by combining NEXAFS at the Carbon and the Oxygen K-edges with photoemission measurements of the core levels and the valence band, completed by resonant photoemission investigations. Despite of the significant difference between the NTCDA size and the metal lattice, well-ordered islands of considerable size are formed and show crystalline structure in the LEED images (Fig.01). In the monolayer regime, NTCDA grows flat on Ag(111) and is covalently bound to the substrate via the conjugated π-system of the naphthalene core [1]. At higher coverage, the molecules tend to be oriented perpendicular and form a densely packed structure similar to the one of NTCDA bulk crystal. We plan to study these transitions by looking closely to changes in the electronic structure at various thicknesses. Except some data on the valence band including the surface states (Fig.02), NTCDA/Au(111) has been marginally investigated; neither the core levels photoemission nor the adsorptions spectra have been taken up to now. Our purpose here is to perform the missing experiments in order to, first, learn about the influence of the interaction at the interface on the molecule orientation and second, compare to NTCDA/Ag(111). The reason of the significantly weaker bonding of the molecule with Au(111) than with Ag(111) is still a mystery, especially as we know that the gold 5d-bands are closer to the Fermi level than the Silver 4d-bands. In other words, we would like to answer the following question: Why an electrons transfer develops from Ag(111) to NTCDA giving rise to an hybridization band, while a repulsive interaction characterizes the NTCDA/Au(111) interface? The present system is our favorite candidate for future measurements on dynamic processes using the femto-laser installation at TEMPO beamline.

Fig.02 : ARPES



[1] *A. Bendounan, et al. Surf. Sci.* ***601****, 4013 (2007).*

Techniques in use : Synchrotron radiation, Angle resolved photoelectron spectroscopy (ARPES), Time-resolved Photoemission, Near Edge X-ray Absorption Fine Structure (NEXAFS), Low-Energy Electron Diffraction (LEED), Surface preparation techniques, Molecular beam deposition.

Applicant skills : motivation, tenacity, curiosity, knowledge on condensed matter physics and chemistry, notions of spectroscopy.

Granted internship : yes (600-900_€ net/month depending on duration)
C'nano IdF laboratory (France only) : yes
Possibility for a thesis : No offer for PhD grant at the moment