


Internship proposal 2009-2010

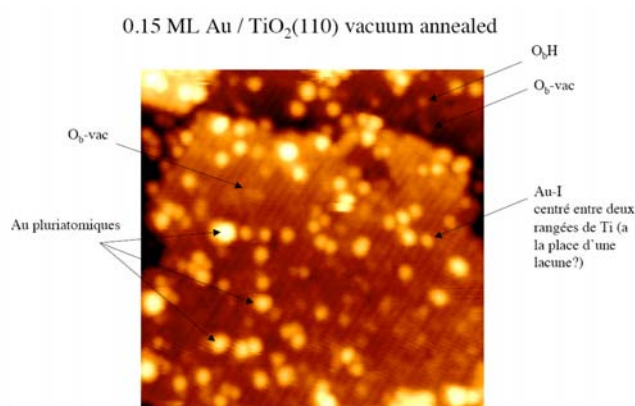
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Supported catalytic gold nanoparticles: role of surface defects

Scientific project

The catalytic properties of supported gold have attracted a huge interest since their discovery twenty years ago, as both bulk gold and supports are poorly reactive. In particular, gold catalysts have the fascinating capability to promote the **oxidation of carbon monoxide** at temperature lower than the ambient, a promising property for indoor purification. Two parameters have been shown to play a major role in the catalytic activity of gold for that reaction: the size of the nanoparticles and the nature of the support (reducibility and presence of oxygen vacancies). Concerning size effect, combined *in situ* X-ray diffraction analysis and reactivity measurements (ESRF, Grenoble) allowed us to characterize the behavior of the “average” particle. For sizes below 4 nm, a strong increase in reactivity upon size decrease was observed. The catalytic behavior could be linked to the particle size and crystallography.

Now, we would like now to examine a “unique” particle by Scanning Tunneling Microscopy (STM) in the case of Au/TiO₂(110) used as a model catalyst. The idea is to determine the **role of surface defects** (which can be observed at the atomic resolution on TiO₂(110), see Fig: oxygen vacancies, OH groups, adsorbed oxygen atoms) **in the nanoparticles growth and reactivity**. Reactivity will be studied via mass spectrometry measurements in a “high pressure” cell connected to the STM chamber.



Besides the laboratory measurements by near field-microscopy (topography and spectroscopy), photoemission (surface chemistry) and mass spectrometry (reactivity), the student will have the opportunity to take part in the first measurements of high pressure infra-red spectroscopy at Synchrotron SOLEIL that are aimed at unraveling the nature of the reactive sites on Au/TiO₂(110).

Techniques in use: Characterization techniques of surface science under ultra-high vacuum: Near field microscopy (STM), Photoemission spectroscopy (XPS/UPS), Electron diffraction (LEED/RHEED), UV/visible optical spectroscopy, Chemical reactivity from mass spectrometry

Applicant skills : Good knowledge in solid state physics and surface physics; interest in laboratory experiment

Granted internship : yes (~300 €/month)

C'nano IdF laboratory (France only) : yes

Possibility for a thesis : yes (type of grant : Grant from French university)