DIRECTION DES SCIENCES DE LA MATIERE,
INSTITUT RAYONNEMENT MATIÈRE DE SACLAY

SERVICE DE PHYSIQUE ET DE CHIMIE DES SURFACES ET DES INTERFACES

# SEMINAIRE *

Jeudi 14 janvier 2010 à 11h00

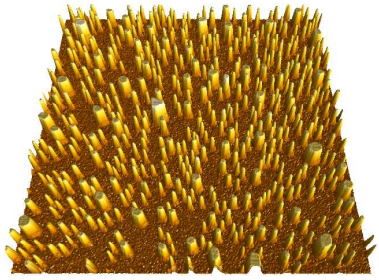
Bâtiment 466, salle 111 - CEA Saclay, 91191, Gif sur Yvette

# Metallic nano-island height control and liquid-like diffusive motion at low temperatures in Pb/Si with text book Quantum Mechanics


## Michael C. Tringides

***Department of Physics, Iowa State University and Ames Laboratory - US-DOE***

*Invité par Patrick Soukiassian*

A nanostructures become smaller in size the confined electrons occupy discrete energy levels because of Quantum Size Effects (QSE). It has been a standard search with spectroscopic probes (ARPES, STS etc) to correlate the measured energy spectra with the geometry of epitaxially grown metallic films. However it was an unexpected surprise when it was found that for Pb/Si(111) the reverse is true as seen in STM and SPA-LEED experiments, i.e., islands of single 7-layer height are grown with unprecedent δ-function height distribution because of the modulation of the QSE energy with height. This is an intriguing growth mode where the island geometry is determined by the electronic structure of the islands and opens up new ways to control the dimensions of nanostructures in Nanotechnology.

The QSE energetics provides only part of the reason since kinetics must be also unusually fast for the islands to assemble within a few minutes at the relatively low temperatures T~150K. Coarsening experiments in a mixture of unstable and stable islands (generated at high flux rates) have revealed a novel type of non-classical coarsening: island decay depends mainly on island height than island curvature as in classical coarsening. In addition the unstable islands transform to stable islands very quickly because the dense wetting layer between the islands moves collectively transferring atoms to the stable islands at rate much higher than normal diffusion. This unusual mass transport has been confirmed in real time experiments with Low Energy Electron Microscopy where the wetting layer displays a “liquid-like”super-diffusive behavior. The refilling of an initial vacant circular region generated by a laser pulse occurs ballistically at constant speed x/t instead of the normal $x/t^{1/2}$ diffusive motion (where x is the profile edge). Since the nano-islands have different electronic structure depending on their height, it was found that nucleation and adsorption depend dramatically on height. It is an open question to discover other systems where such unusual QSE-driven self organization is present.

In collaboration with M. Hupalo, S. Binz, C.Z. Wang, K.M. Ho, Z. Chvoj, Z. Kuntova, P. Miceli, E. Conrad, M. Altman, M. Loy.

*** SERA PRECEDE D'UNE PAUSE-CAFE A PARTIR DE 10H30**

*Formalités d'entrée : Contacter le secrétariat pour l'établissement de votre autorisation d'entrée sur le centre de Saclay. Tel : 01.69.08.65.32 ou 01.69.08.40.12; Fax : 01.69.08.40.44 ; e-mail : catherine.julien@cea.fr. Le délai minimum est de 24 heures pour les visiteurs ressortissants des pays de l'Union Européenne, et de huit jours pour les autres. Sans autorisation, vous ne pourrez entrer sur le centre de Saclay. Dans tous les cas, se munir d'une pièce d'identité.*