School of Physics

Research project in **Nanoelectronics/Nanotechnology**

Research project in **Theoretical & Computational Solid State**

Templating of organic thin film growth:
organic molecular semiconductors, nanomeshes and graphene nanoribbons

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X-ray Spectroscopy Group

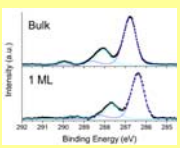
Scientific Background / Current Research

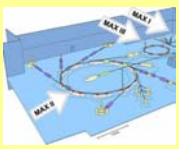
Controlled structured growth of organic materials, organic molecular semiconductor thin films as well as graphene in particular, is of importance for future devices where either interfaces or local intermolecular forces dominate in determining the structure and, as it turns out, the most useful device characteristics.
This project will seek to perform measurements of the **adsorption**, **chemical bonding** and **electronic structure** of organic molecular semiconductor materials forming either heteroepitaxial organic thin films on inorganic semiconductor or metal surfaces, or in the formation of covalently bonded organic nanostructured networks on inorganic semiconductor or metal surfaces. Where possible **real-time in-situ** measurements will be made to probe intermolecular forces in thin films. Of particular interest is growth templating on stepped or terraced vicinal single crystal metal surfaces which may allow for useful regular nanoribbons of graphene to be formed by MOCVD. Associated density functional theory calculations of adsorption, electronic structure, and x-ray spectroscopy on these surfaces may play a significant part of this project.

Project

Measuring adsorption, chemical bonding and electronic structure of organic molecular semiconductors or thin films requires ultra high vacuum chambers, organic molecular beam deposition or MOCVD growth and XPS or UPS photoemission, all available in TCD. Other x-ray spectroscopic techniques are available at international **synchrotron radiation** facilities, while **real-time in-situ** measurements, as well as scanning probe measurements of these interfaces, surfaces and films to occur in collaborators laboratories. Research will be in collaboration with groups in Chemistry (G. Duesberg), Dublin City University (A. Cafolla), Aberystwyth, Wales (A. Evans) and Boston U. (K. Smith) with measurements at synchrotron radiation facilities such as MAXLAB in Sweden or National Synchroton Light Source, NY USA.

MAXLAB

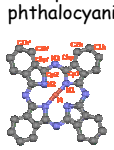




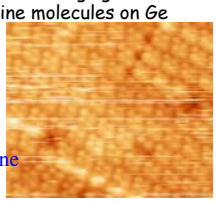
Photoemission of monolayers of organic molecules on surfaces: C 1s XPS of Pb-Pc

International synchrotron radiation facilities: MAXLAB in Lund, Sweden, where photoemission and x-ray absorption measurements take place.

Example of STM imaging of phthalocyanine molecules on Ge



phthalocyanine



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More information / References