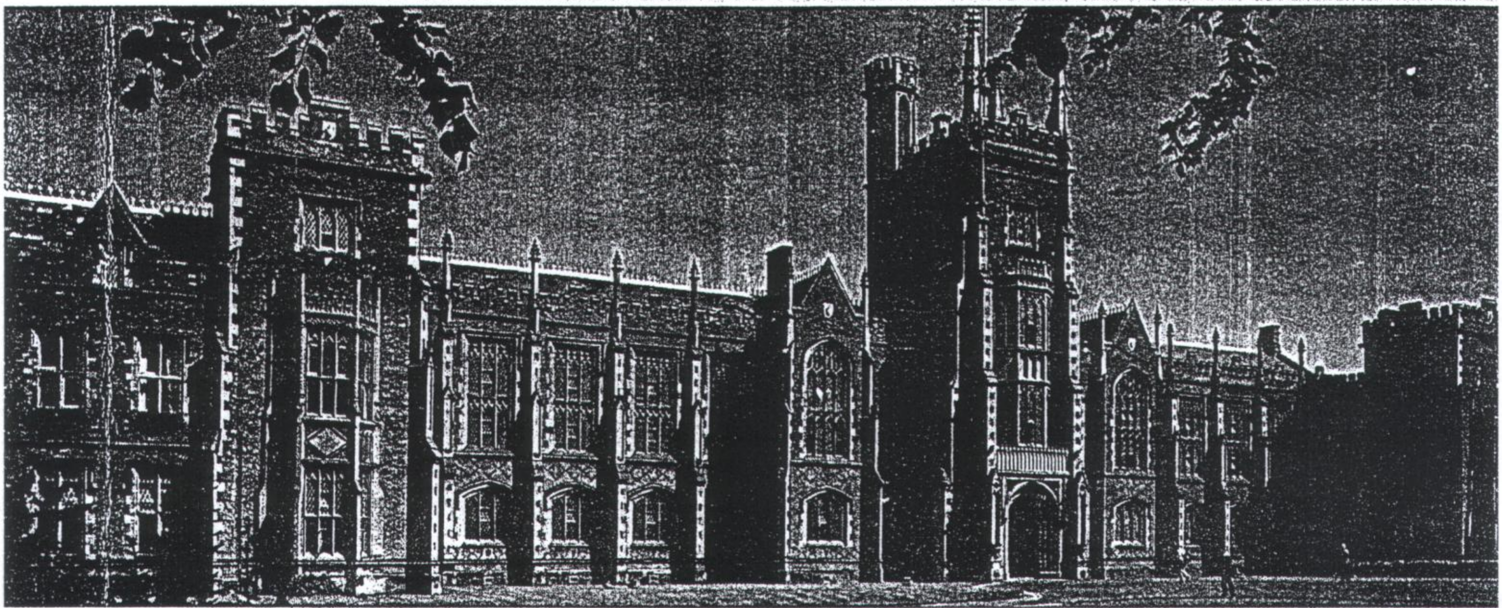
Programme and Abstracts



Condensed Matter and Materials Physics (CMMP) Conference

6 - 9 April 2003
Queen's University Belfast

Institute *of* **Physics**

B05

conditions, changes to the surface probably due to hydrogen dissolution are observed.

NP1.P.1.10
Patterns and Pathways in Nanocrystal Self-Assembly

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Au nanocrystals spin-coated onto silicon from toulene and hexane form a variety of fascinating and highly structured patterns including cellular networks ('nanofoams', Fig. 1), interconnected labyrinths, and spatially correlated droplets [1]. The qualitative similarity with patterns arising from spinodal phase separation [2] in polymer mixtures and binary fluids is particularly striking. A quantitative statistical crystallography [3] analysis of the cellular systems shows that intercellular correlations drive the networks far from statistical equilibrium. Mechanisms based on Marangoni convection - the phenomenon previously suggested as the origin of honeycomb and 'hexagonal' nanocrystal networks on amorphous carbon substrates - cannot alone account for the variety of patterns observed for Au nanoparticles on Si. We argue that spinodal decomposition plays a key role in the formation of the family of network arrays observed.

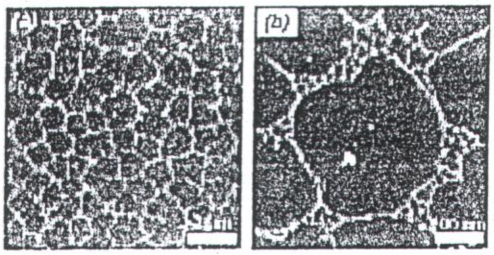

Figure 1.

NP1.P.1.11
Growth of Single Crystal Pentacene Transistors on Polymers

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The vacuum sublimation of pentacene crystals onto Si/SiO2 wafers spin coated with PMMA has been investigated. For deposition at room temperature, multilayer terraced grains are observed. However, for substrate temperatures greater than 78 degree, the sticking coefficient falls drastically and isolated monocrystalline islands are formed with widths up to 20um. Over this temperature, near circular monolayers of pentacene are formed (Figure 1(a)) for low coverage. This is due to the reduced residence time, and thus nucleation rate, of adsorbed molecules on PMMA. The influence of deposition rate, deposition time and substrate temperature on the growth mechanism has been investigated. Following the initial stage of monolayer growth, lateral growth is limited by the nucleation of second layers, rather than the presence of neighbouring islands. Diffusive capture of molecules leads to roughening of the island while incorporation of molecules directly incident on the monolayer leads to smoothening the island edges. After nucleation of a second layer, which normally occurs at the edge of the islands, the smoothening is suppressed. As shown in Figure 1(b), most of the multilayer islands are thickest at their edges and needle-like dendrites grow out from the edge. This dendritic growth is due to diffusive capture of molecules. Source and drain contacts have been attached to isolated multilayer, bilayer and monolayer pentacene islands and their transistor action has been investigated. Mobilities up to 0.2cm2/Vs are observed for multilayer crystals while reduced mobilities are observed for bilayer and polycrystalline monolayer islands.

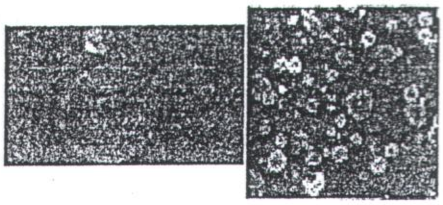

Figure 1.

NP1.P.1.12
Optical Parameter of Spin Coated Thin Films using Poly(Methyl Methacrylate) Polymer

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A series of poly(methyl methacrylate) (PMMA) has been synthesised with a range of different temperatures and initiator concentrations using Emulsifier-Free Emulsion polymerisation method. Spin coated PMMA polymer thin films with four different lengths of the same tail group have been chosen to study their optical parameters and benzene vapour sensing properties using ellipsometry, Surface Plasmon Resonance (SPR) and Atomic Force Microscopy (AFM). These materials are deposited onto a gold-coated glass substrate for SPR measurements and onto a silicon substrates for the ellipsometry and AFM measurements. The refractive index and thickness of these PMMA polymer materials are obtained from ellipsometry and SPR measurements. SPR curve measurements have also been used to obtain curve shifts as a result of benzene vapour exposures. The kinetic behaviour of PMMA films against benzene vapour has also been studied. AFM is used to study the surface morphology of the PMMA films and the results showed that the film surface is uniform and PMMA materials are well suited for spin coating.

NP1.P.1.13
Tip-Enhanced Raman Microscopy: Practicalities and Limitations

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The feasibility of an apertureless scanning near-field Raman microscopy, exploiting the local enhancement in Raman scattering in the vicinity of a silver or gold tip, is investigated. Using the finite difference time domain method we calculate the enhancement of electric field strength, and hence Raman scattering, achieved through the resonant excitation of local modes in the tip. By modelling the frequency dependent dielectric response of the metal tip we are able to highlight the resonant nature of the tip-enhancement and determine the excitation wavelength required for the strongest electric field enhancement, and hence Raman scattering intensity, which occurs for the excitation of modes localised at the tip apex. We