SYSO 1: Self-Organizing Surfaces and Interfaces I

Time: Wednesday 14:00–15:30 Location: BAR SCHÖ

Invited Talk SYSO 1.1 Wed 14:00 BAR SCHÖ

Pattern formation in epitaxial growth and ion beam erosion — •Thomas Michely — II. Physikalisches Institut, Universität zu Köln, Germany

In this talk I will discuss three examples for self organisation on solid surfaces under conditions far from thermodynamic equilibrium. The first example relates to cluster lattice formation on a graphene moiré, a situation where adding under non equilibrium conditions the same particles as those forming one system phase causes a dramatic amplification of a spatial inhomogenity in the second system phase which in turn gives rise to a highly ordered and spontaneous arrangement of the added particles. The second example relates to crystal growth. The competition of random deposition and specific diffusion mechanisms leads to a self organized morphology of mounds. The characteristic length scales displayed allow one to read the fundamental atomistic parameters of diffusion from the pattern. At proper growth conditions a growth bifurcation takes place, where dependening on whether a specific feedback mechanism was turned on or not the system displays patches of qualitatively different structure. Finally we briefly address the topic of self organisation of ion beam eroded surfaces, which for crystalline substrate may be considered as the inverse process of crystal growth.

Invited Talk SYSO 1.2 Wed 14:30 BAR SCHÖ

Patterns and Pathways in Far-from-equilibrium Nanoparticle Assemblies — •Philip Moriarty[1], Andrew Stannard[1], Emmanuelle Pauliac-Vaujour[1], Matthew Blunt[1], Chris Martin[1], Ioan Vancea[2], and Uwe Thiele[2] — [1]School of Physics and Astronomy, University of Nottingham, Nottingham NG7 2RD, UK — [2]Department of Mathematical Sciences, Loughborough University, Loughborough, Leicestershire, LE11 3TU, UK

Nanoparticle-solvent films deposited on solid substrates are associated with a rich dynamic behaviour which gives rise to a wide variety of striking self-organised patterns [1-4]. Although close-to-equilibrium self-assembly of nanoparticle arrays has been studied in some depth, there has been rather less work on solvent-nanoparticle systems driven far from equilibrium. In the far-from-equilibrium regime, a remarkably broad array of intricate, spatially correlated patterns form including "foam-like" cellular networks, labyrinthine structures similar to those formed in spinodal decomposition of binary fluids, and well-defined fractal morphologies. I shall focus on our recent results in two areas: (i) "coerced coarsening" of nanoparticle arrays where the system is mechanically driven towards equilibrium [3], and (ii) the use of scanning probe-defined silicon oxide patterns to direct solvent dewetting and thus control pattern formation in drying nanofluids [4].

1. G. Ge and L. Brus, J. Phys. Chem. B 104 9573 (2000) 2. E. Rabani et al., Nature 426 271 (2003); T.Bigioni et al., Nature Materials 5 265 (2006) 3. MO Blunt et al., Nature Nanotech. 2, 167 (2007) 4. CP. Martin et al., Phys. Rev. Lett. 99, 116103 (2007)

Invited Talk SYSO 1.3 Wed 15:00 BAR SCHÖ

Block-Copolymer Derived Inorganic Functional Materials — •Ullrich Steiner — Cavendish Laboratory, Department of Physics, University of Cambridge

Block-copolymer self assembly gives rise to highly organised structures on the 10-nm length scale. While this is well documented, the use of these self-assembled structures for the manufacture of functional materials that make use of their high degree of symmetry is rare. This is mainly due to the the fact that text-book self assembly is limited to simple coil-coil copolymers, preventing the the use of technologically more relevant materials.

A promising alternative to the direct manufacture is the use of generic, well studied copolymers as template for materials synthesis. Three separate approaches will be discussed. (1) Well defined interpenetrating porous networks arising from partial degradation can be replicated by electroplating or atomic layer deposition to yield an organic-inorganic composite material. (2) The incorporation of a suitable precursor molecules into one of the block-copolymer phases followed by a condensation reaction compartmentalises sol-gel chemistries to a 10-nm confinement, replicating the microphase morphology of the block copolymer. (3) The growth of a single crystal in the vicinity of a porous copolymer phase results in the formation of a highly structured single-crystalline material.

My talk will introduce these three strategies for the manufacture of nanomaterials and demonstrate their usefulness in the manufacture of dye-sensitised solar cells.