

PHILIPP ZEIGERMANN, MICHAEL BLECH, MATHIAS STEGLICH, and BERND SCHRÖTER — Universität Jena, Institut für Festkörperphysik, Max-Wien-Platz 1, 07743 Jena, Deutschland

A controlled growth of carbon nanotubes with particular structural and electronic properties at predefined positions on solid substrates is a prerequisite to utilize them in electronic or nano-optical devices. We grow single-wall nanotubes by thermal chemical vapour deposition (CVD) on various substrates like silicon, fused silica and sapphire as well as on silicon carbide. Metal films are vacuum-evaporated to catalyze the growth of high-purity single-wall nanotubes by CVD using methane as precursor gas. The quality of nanotubes is tested by Raman and x-ray spectroscopy: residual catalyst amount and contamination is in general lower than the detection limits of these techniques. The morphology and orientation of the nanotubes is characterized by scanning electron and atomic force microscopy. A preferred orientation is observed on the (single-crystalline) surface of sapphire.

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Self-selection and Error Correction in Multi-ligand Supramolecular Networks at Surfaces — ●STEVEN L. TAIT¹, ALEXANDER LANGNER¹, NIAN LIN¹, CHANDRASEKAR RAJADURAI², MARIO RUBEN², and KLAUS KERN^{1,3} — ¹Max-Planck-Institut für Festkörperforschung, Stuttgart — ²Forschungszentrum Karlsruhe GmbH — ³Ecole Polytechnique Fédérale de Lausanne, Switzerland

Supramolecular networks stabilized by metal-organic coordination can be designed to self-organize in regular, two-dimensional lattices at surfaces, whose dimensions and properties can be controlled by selection of the organic ligand components. This approach offers a natural and highly efficient alternative to current nano-fabrication methods and provides a model system for (bio-)molecular assembly. With high-resolution scanning tunneling microscopy of such networks, we demonstrate structural error correction during assembly achieved by active molecular self-selection. Experiments were made by deposition of Fe atoms and organic ligands at the Cu(100) surface. Binary mixtures of complementary ligands allow for constructions of highly-ordered 2D arrays of compartments, whose shape and size can be predictably programmed by modular ligand replacement. Redundant mixtures of ligands of different sizes demonstrate the ability of the system to correct structural errors and achieve a high degree of order by sorting themselves into rows according to molecule size. We contrast this with a ligand mixture where the energy landscape of the intermolecular interactions does not activate an error correction mechanism, but rather provides a route for structural error tolerance.

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Growth of SiGe nanoislands on prestructured silicon substrates — ●MARLEN SCHULZE, ANNE-KATHRIN GERLITZKE, and TORSTEN BOECK — Institute for Crystal Growth in the Forschungsvereinigung Berlin e. V.

Coherently strained and highly ordered silicon-germanium nanoscale pyramids on silicon, grown by liquid phase epitaxy (LPE) via the Stranski-Krastanov growth mechanism are very interesting objects to reduce the size of semiconductor devices. Generally, LPE is very well appropriate to study fundamental atomistic processes at the liquid-solid interface because it operates very close to thermodynamical phase equilibrium.

A patternlike array of SiGe nanostructures has been realised on prestructured silicon substrates. Si(100) substrates have been patterned by squarelike oxide stripes using local oxidation nanolithography in an atomic force microscope (AFM). The width of the stripes is precisely controlled by progress of the lateral oxidation. Subsequently, LPE was employed to grow SiGe nanoislands on the prepatterned substrates. The truncated pyramids are arranged within the oxide-free cavities directly along the stripes. The final island size significantly probes an effectively lowered lattice mismatch, i.e. a locally expanded crystal lattice in noncovered areas of the silicon substrate.

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Surface-induced handedness in adsorbed layers — ●PHILIPP SCHMIDT-WEBER¹, THORSTEN KAMPEN¹, ARANTZAZU MASCARAQUE², ROCIO CORTEZ², JAN-HUGO DIL¹, and KARSTEN HORN¹ — ¹Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin — ²Universidad Autónoma de Madrid, Spain

Molecules that are achiral in the gas phase may acquire a chiral character through the loss of symmetry elements, which has a strong influence on their arrangement in long-range ordered structures. We have

studied stilbene and its derivatives, using STM, LEED and photoemission with the aim of identifying such ordering processes. Dicarboxystilbene (DCSB) loses its carboxyl hydrogen atom when adsorbed on Cu(110), and acquires a handedness on the surfaces which is readily seen in STM images. The two enantiomers then arrange in different long-range ordered structures ("herringbone" and "parquet" patterns), which themselves possess a handedness, i.e. they exist in a dextro- and laevo-form. Using STM images in which both the substrate and the adsorbate are imaged with atomic resolution, we were able to identify two distinct types of adsorption sites as basic building blocks of the long-range structures. One of these (the "parquet" pattern) is enantiomerically pure, while the other ("herringbone") is a racemic structure. The fact that the latter is the thermodynamically stable one can be understood from general thermodynamic principles.

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Comparative study of the structure formation by two different bis(terpyridine)derivates (BTP) on HOPG — ●MICHAEL ROOS¹, CHRISTOPH MEIER², DANIEL CATERBOW², HARRY E. HOSTER¹, ULRICH ZIENER², and R. JÜRGEN BEHM¹ — ¹Institute of Surface Chemistry and Catalysis, Ulm University, D-89069 Ulm, Germany — ²Institute of Organic Chemistry III, Ulm University, D-89069 Ulm, Germany

Deposition of BTP molecules on HOPG by evaporation in UHV or from solution leads to large domains of highly ordered structures, which are stabilized by C-H...N type hydrogen bonds [1-3]. The energetically most favorable molecule-molecule configuration can be modified by varying the position of the N-atoms within the BTP molecules. Furthermore, depending on the deposited amount and the deposition conditions (solvent and concentration), a large variety of ordered structures is obtained. The possibility to describe these structures as a sum of localized molecule-molecule and molecule-substrate interactions is discussed. In addition, the role of dynamic effects like molecule mobility and rotation for the stability of the different phases is considered.

1. H. E. Hoster et al., *Langmuir* 23, 11570 (2007).
2. A. Breitruck et al., *Surf Sci* 601, 4200 (2007).
3. C. Meier et al., *J Phys Chem B* 109, 21015 (2005).

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SERS and single-molecule SERS in metallo-dielectric structures — ●MANUEL RODRIGUES GONÇALVES, ANDRÉ SIEGEL, and OTHMAR MARTI — Ulm University, Institute of Experimental Physics, Albert-Einstein-Allee 11, D-89081 Ulm, Germany

Surface enhanced Raman scattering (SERS) refers to a technique to enhance the Raman scattering cross section of few molecules adsorbed on metallic surfaces, in order to achieve high enhanced spectra. Despite its success as a chemical identification technique at very low molecular concentrations, its main drawbacks are the extreme sensitivity to the electromagnetic enhancements of the metallic structures, the poor reproducibility, and the fabrication of structures with defined strong field enhancements at specific wavelengths.

Single-molecule SERS requires very high field enhancements, of the order of 10^{14} . The Raman spectra of very few, or single molecules present a blinking behaviour. It is commonly accepted that the blinking is characteristic of the Raman spectra of single molecules, adsorbed at metallic clusters or structures with extreme enhancements.

We have fabricated metallo-dielectric structures suitable for SERS using colloidal crystals as templates. The fabrication of the structures is reproducible. FEM and FDTD calculations indicate that very high field enhancements can be expected. Experiments using a confocal Raman microscope find blinking SERS at the predicted locations. This is an indication of a low number of molecules in the detection volume.

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Nanosecond-laser interference patterning at 266nm wavelength — ●MIKE HETTICH, STEPHEN RIEDEL, PAUL LEIDERER, and JOHANNES BONEBERG — University of Konstanz, Department of Physics, D-78457 Konstanz, Germany

Direct laser interference patterning by ns-laser pulses allows producing periodic surface structures in a single illumination step. For that purpose thin metallic films (Au, Ta) or Si wafers are irradiated by two or more interfering laser beams. The local intensity variations achieved in this way induce lateral flow of material. We show that this enables achieving structures with a periodicity down to 150nm, if the fourth harmonic of a ns-Nd:YAG-laser is used. Upon moving the substrate laterally between the first and subsequent illumination steps, structure periods below $\lambda/2$ can be realized.