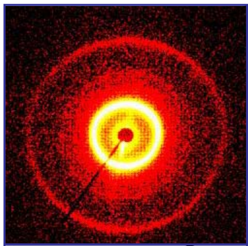
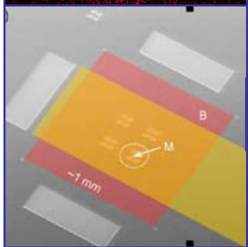
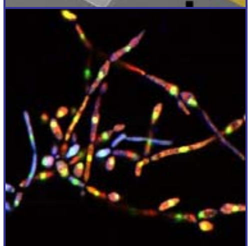
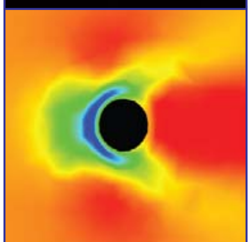
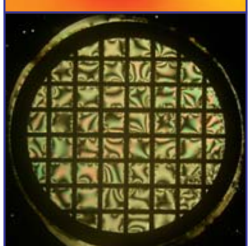
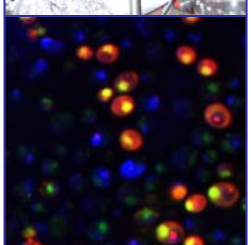
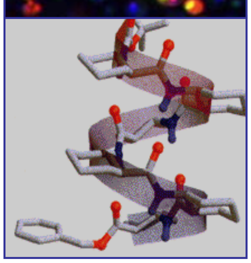






UWAMIC

NEWSLETTER

Spring-Summer 2009, Volume 3, Issue 1

A Message from the Directors

Welcome to the Spring-Summer 2009 UWAMIC Newsletter!

Your consortium continues to grow as we add 6 new members this year: NanoInk, EarthMimic, Nano Imaging Devices, FiveAsh Data Management, Silatronix, and SolRayo. Additionally, a lot of activity has taken place since the last annual meeting. I have brief summarizes of the updates below; please feel free to email or call for additional details.

Membership Fees: In response to the tough economic conditions, and to encourage a broader range of member companies to participate, we have changed our fees for the 2009-2010 period as indicated in the table below:

2009 Membership Categories	
General Membership	$8,500
Collaborative Member (requires active collaboration with a UW group or facility)	$5,000
Small Business Membership (fewer than 20 employees)	$2,500
Startup Company (fewer than 5 employees)	$250

This change was suggested by our Industrial Advisory Board and approved by all three directors. This is a substantial reduction; please help spread the word to interested colleagues. We will also switch membership periods to match the calendar year so watch for your prorated renewal notice soon.

Website Updates: Since we haven't had a lot of response, I would like to repeat my request that you visit the website (www.uwamic.wisc.edu) and register for member privileges. The site has new features, including a place for members to post jobs for students and an agenda and poster list archive for each annual meeting. If you would like a copy of a poster, simply email us and indicate the format you would like it sent in.

Member Showcase: In April we held our first Member Showcase. The meeting consisted of member companies sharing with us and other members what they do and provided opportunities to network and form collaborations that can benefit multiple parties. This year six companies presented, and at least two collaborations were made, as well as a possible equipment placement with another member. Due to its success, we plan to make this an annual event.

Katie DeBruin remains the primary contact for the UWAMIC website and events (608-262-0112 or kedebruin@wisc.edu). Please contact her or me for help of any kind.

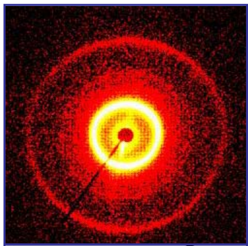
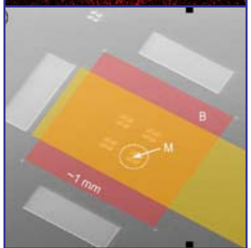
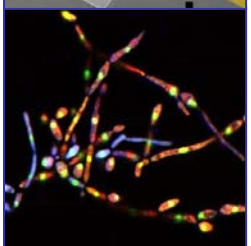
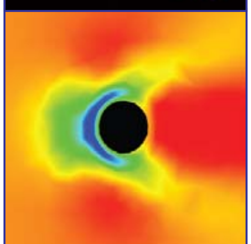
Enjoy this issue of the newsletter. As always we welcome your feedback as to how we can improve your consortium and the newsletter, and we appreciate you sharing this newsletter and our website information with colleagues you think may be interested in knowing more about our program.

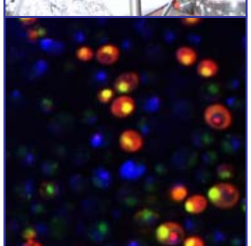
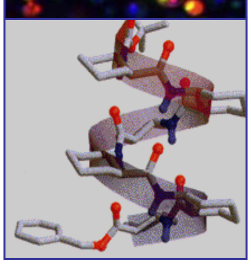
Regards,

Jon J McCarthy

Co-Director, Development

Email:uwamic@mailplus.wisc.edu•Phone:(608)262-0112•Fax:(608)265-4036

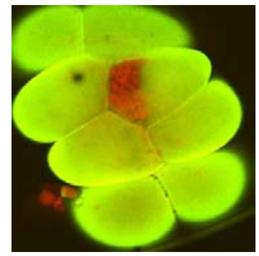




UWAMIC in the News

Max Lagally Named MRS Fellow

The Materials research society (MRS) named Erwin W. Mueller Professor and Bascom Professor of Surface Science **Max Lagally** an MRS fellow. Fellowship honors members whose sustained and distinguished contributions to materials research are internationally recognized. MRS will recognize new fellows at the 2009 spring meeting, April 13-17 in San Francisco. Less that 0.2 percent of MRS members are named fellows each year, and fellowship is a lifetime appointment.

Art of the Very Small on Display at Dane County Airport



Artful images of the very, very small — cells, molecules and nanoscale structures — will be on display beginning Friday, April 24, at the Art Court of the Dane County Regional Airport. The show, "Tiny: Art From Microscopes at UW-Madison," will be open through September and features the beautiful images generated in the course of research by UW-Madison biologists, engineers and physical scientists, including images from **MRSEC** and **NSEC** laboratories. The show is free and open to the public. http://www.news.wisc.edu/16566

James Dumesic Recognized by AAAS

James Dumesic, Steenbock Professor in the Department of Chemical and Biological Engineering, was among four UW-Madison scholars elected to The American Academy of Arts and Sciences 2009 class of fellows. Established in 1780, the academy studies contemporary issues influenced by science, humanities, culture and education. The goal of electing an annual class of fellows is to enhance its ability to conduct interdisciplinary, long-term policy research. Dumesic is renowned for research in kinetics and catalysis, surface and solid-state chemistry. His research has appeared in the Journal of Physical Chemistry, the Journal of Chemical Physics, the Journal of Catalysis and more. http://www.news.wisc.edu/16613

Susan Coppersmith Elected to National Academy of Sciences

Susan N. Coppersmith, a University of Wisconsin-Madison professor of physics, was elected to the prestigious National Academy of Sciences in recognition of her "distinguished and continuing achievements in original research." Coppersmith is a theoretical physicist who explores the fundamental properties of many types of matter. At UW-Madison, she has studied how crustaceans form their shells, how advanced computers may operate at the atomic scale, and, in collaboration with the university's Nanoscale Science and Engineering Center, how to manipulate matter at scales of a few billionths of a meter.http://www.news.wisc.edu/16633

Juan de Pablo Received Byron Bird Award for Excellence in Research Publication

Through a series of nine research articles — each one of which colleagues worldwide consider a 'landmark' publication — Howard Curler Distinguished Professor of Chemical and Biological Engineering **Juan de Pablo** has demonstrated unprecedented advances in developing powerful computational methods that enable researchers to conduct molecular simulations of complex fluids, earning him the honor of being awarded the Byron Bird Award for Excellence in Research Publication. With his students, de Pablo has invented new simulation methods, algorithms and theoretical formalisms that are key to establishing quantitative relations between atomic-level structure and interactions, processing conditions, macroscopic properties, and performance in applications.http://www.engr.wisc.edu/news/headlines/2009/May11.html

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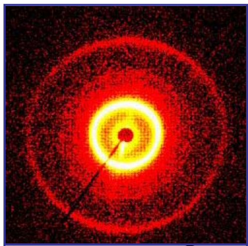
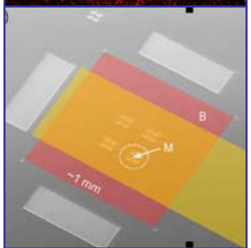
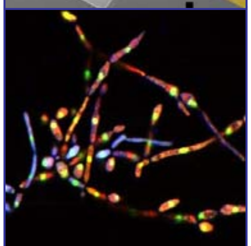
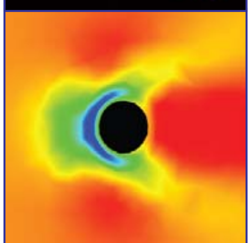
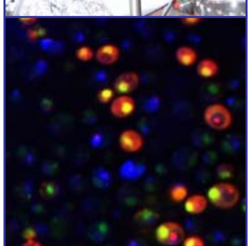
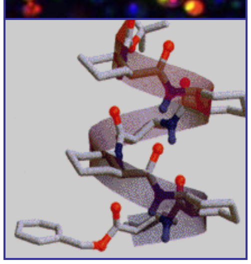
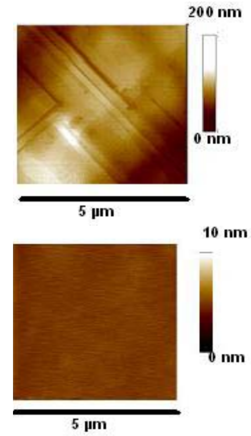





Research Highlights

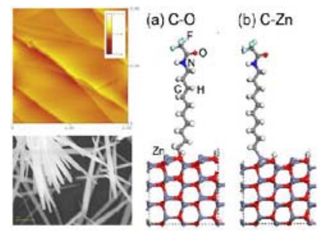
Dislocation-Free Fully Relaxed SiGe Substrate



To make modulation-doped 2-dimensional electron-gas structures for applications in quantum electronics, the requirements on the quality and strain state of the materials for the Si/SiGe heterojunctions are extremely stringent. Defect-free strained silicon and silicon/germanium alloy will be ideal. Such perfect materials currently do not exist. We have developed a new process for fabricating defect-free strained-Si-based materials. While strained Si is well established, the material is far from perfect, containing dislocations and non-uniform strain. Electron scattering reduces performance of modulation-doped strained-Si quantum wells. Interface roughness and non-uniform strain contribute to electron scattering, and hence must be minimized. These new materials will make possible fundamentally new experiments in quantum electronics. Improving the Si material quality may also improve device uniformity and performance of high-mobility electron channel devices. http://mrsec.wisc.edu/MR--Nugget.php?ID=25

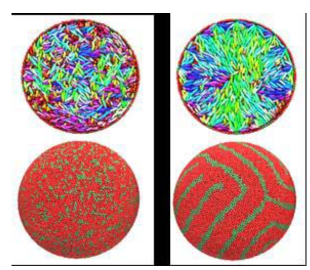
Making "Smart" Oxides Using Molecular Layers

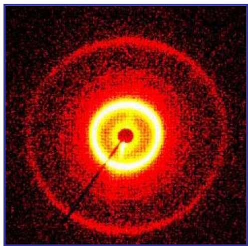
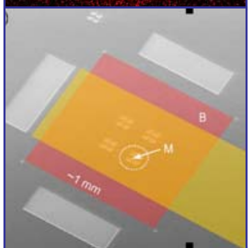
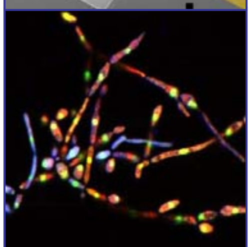
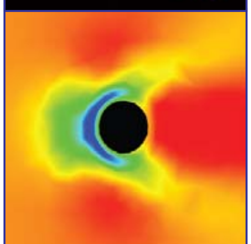
Organic molecular layers can provide useful ways to interface oxide materials with organic and biological materials. The Mavrikakis, Hamers, Kuech, Gopalan, and Evans group at the University of Wisconsin MRSEC have collaborated to develop a new way to modify the surface properties of planar ZnO surfaces and of ZnO nanowires. Organic alkenes will graft to ZnO when illuminated with ultraviolet light, producing well defined organic-inorganic interfaces. Computational studies are being used to compare with infrared, Raman, and Photoemission spectroscopies to understand the nature of the bonding and the electronic properties of the interfaces. We anticipate that this will be an attractive method for tailoring the properties of ZnO and other oxides with organic semiconductors.http://mrsec.wisc.edu/MR--Nugget.php?ID=28

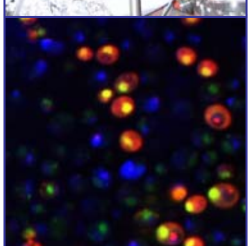
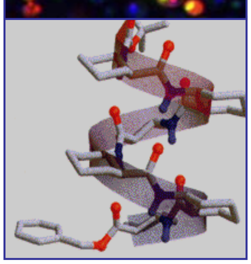


Size-Dependent, Surface-Induced Ordering of Liquid Crystals Observed in Monodispersed Droplets with Micrometer-to-Nanometer Sizes

It is widely appreciated that the supramolecular ordering of polymers, surfactants and liquid crystals (LCs) can be impacted by confinement. In many cases, however, these effects remain poorly understood. This is particularly true for LCs, where confinement-induced ordering in natural systems (e.g., containing DNA and proteins) underlies remarkable material properties such as the strength of spider silk, and confinement in synthetic systems influences the design of LC-based sensors, directed assembly of microscopic and nanoscopic objects, and the interactions of light with LCs. Although it is generally accepted that size-dependent ordering of LCs reflects a subtle competition between bulk and interfacial physicochemical factors, for the important and prototypical case of LC droplet systems, the absence of experimental approaches that permit precise variation of LC droplet size (in relevant size range) with rigorous control over interfacial chemistry, temperature and other key parameters of the system has prevented elucidation of the effects of confinement. To address this fundamental challenge, IRG3 has developed new methods for the synthesis of aqueous dispersions of polymer-encapsulated LC droplets with diameters that span the micrometer-to-nanometer range. This new experimental system has made possible the fabrication of micrometer and sub-micrometer LC droplets with precise control over size and interfacial chemistry, and it has used this capability to unmask size-dependent changes in LC ordering. In particular, the IRG has demonstrated that previous theoretical predictions of LC ordering in the limit of sub-micrometer droplet size are not realized experimentally. Complementary simulations of nanometer-sized droplets decorated with surfactants have revealed that the ordering of the LC within these droplets can lead to spatial patterning of the surfactants on the surfaces of the droplets. The effects of size on LC ordering transitions triggered by the assembly of amphiphiles at the surfaces of the LC droplets have also been demonstrated by the IRG, suggesting new principles for design of LC-based technologies, including chemical and biological sensors.http://mrsec.wisc.edu/MR--Nugget.php?ID=30



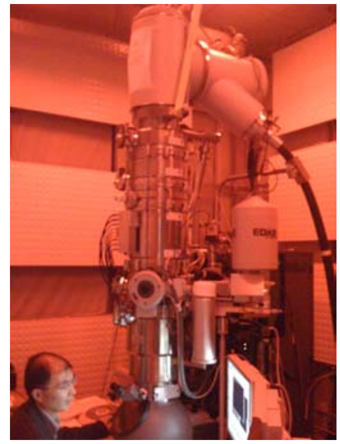





Instrumentation News

MSC's Aberration-Corrected Analytical STEM has Arrived!

As a reminder, this machine will be unique in the upper Midwest and will: (i) enable significant new advances in research in nanomaterials, nanobiology, and energy and the environment, (ii) and enhance training of future scientists, engineers, and EM technicians with new material on STEM.


FEI Titan STEM being installed

The instrument is equipped with full analytical attachments and adds the following capabilities:

Imaging: High-angle annular dark-field (HAADF) "Z-contrast" STEM; low-angle dark-field and bright-field (BF) STEM imaging; simultaneous acquisition of any two imaging signals.

Microanalysis: Electron energy-loss spectroscopy (EELS) at 0.8 eV energy resolution and 2 Å spatial resolution; energy-dispersive x-ray spectroscopy (EDS) at 130 eV energy resolution and <5 Å spatial resolution; simultaneous EELS and EDS spectrum imaging.

Nanodiffraction: Systematic acquisition of electron nanodiffraction patterns from many positions in registry with a STEM image using coherent probes 2 to 50 Å in diameter.

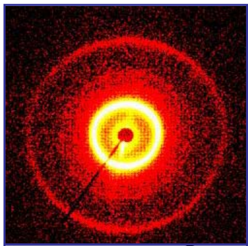
Remote operation: All the STEM (and TEM) capabilities will be operable via the internet.

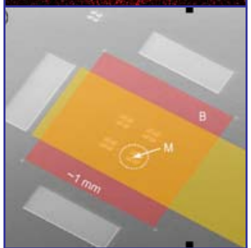
Closed Loop Scanner Upgrade for MSC's Veeco Multimode AFM

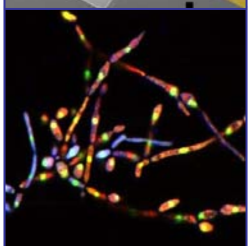
This summer the acquisition of a closed loop sample scanner will improve the capability of the MSC's AFM facility. The standard Veeco tube scanners exhibit significant non-linearity, hysteresis, bow and drift. A closed loop scanner will provide accurate and repeatable positioning of a sample under the AFM tip. This allows a user to pick an area to measure and have the instrument go exactly to that point and then stay there over time. Closed loop scanning is especially important when imaging or analyzing very small areas or making repeated measurements over the same areas. In addition to normal topographic imaging, some of the techniques that can require accurate positioning include force measurements, surface potential measurements, lift mode applications, nanoindentation, nanopositioning and lithography.

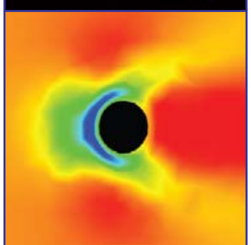
The Veeco Multimode closed loop scanner that we will purchase is made by nPoint, one of our member companies. The nPoint scanner has the additional benefit of a larger Z range (15 μm) than standard Veeco scanners (2.5-5μm). This additional range is useful for many samples, including biological cells, that have more than just a few microns variation in Z. nPoint's near absence of scanner bow allows the measurement of large areas (up to 100 μm x 100 μm) without running out of Z range and without the addition of a significant curved background to the image.

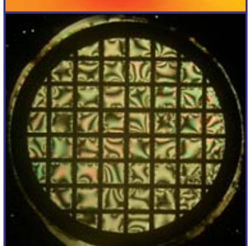
Email:uwamic@mailplus.wisc.edu•Phone:(608)262-0112•Fax:(608)265-4036

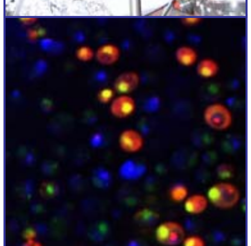


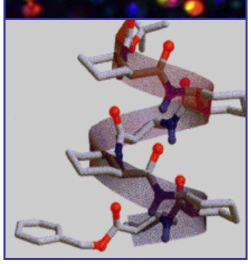










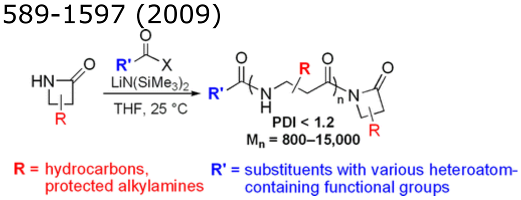


Recent Publications

Access to poly-β-peptides with functionalized side chains and end groups via controlled ring-opening polymerization of β-lactams

J. Zhang, D. Kissounko, S. E. Lee, S. H. Zhang, S. H. Gellman, S. S. Stahl

Journal of the American Chemical Society **131** (4), 1589-1597 (2009)



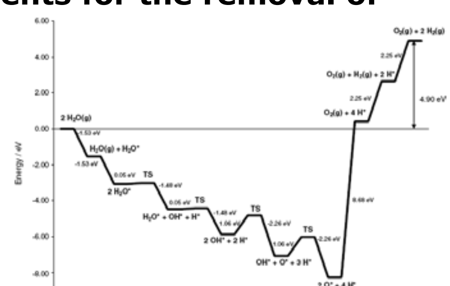
Abstract: Poly-β-peptides are attractive for biomedical applications because the backbone is similar enough to that of proteins for biocompatibility, but the backbone is sufficiently unnatural that these polymers evade proteolytic degradation. Prior investigations of poly-β-peptides have been hindered by two principal limitations: (1) most known examples are insoluble, and (2) the range of accessible side chain functionality has been quite limited (mostly simple hydrocarbon units). The present study describes innovations in poly-β-peptide synthesis that enable the preparation of diversely functionalized examples and provide the basis for broad exploration of the properties and applications of these nylon-3 materials. We describe several β-lactams with a protected amino group in their side chain that readily undergo ring-opening polymerization (ROP). These monomers are available in large quantities via *N*-chlorosulfonylisocyanate (CSI) cycloaddition reactions with functionalized alkenes; previously CSI reactions have been limited to alkenes with hydrocarbon substituents. Postpolymerization deprotection of the amino groups leads to water-soluble poly-β-peptides. In addition, we introduce a simple co-initiation strategy that allows placement of a wide variety of functional groups at the *N*-termini of poly-β-peptide chains. ROP involving the new β-lactams and co-initiation strategy exhibits characteristics of a controlled polymerization and enables the preparation of amphiphilic block copolymers. We have recently shown that cationic copoly-β-peptides made available by these innovations mimic the selective antibacterial activity of host-defense peptides; the results described here provide the foundation for further exploration of this valuable activity and for the pursuit of other biological applications such as DNA/siRNA delivery and tissue engineering.

http://pubs.acs.org/doi/abs/10.1021/ja8069192

Effectiveness of in situ NH3 annealing treatments for the removal of oxygen from GaN surfaces

L. C. Grabow, J. J. Uhlrich, T. F. Kuech, M. Mavrikakis

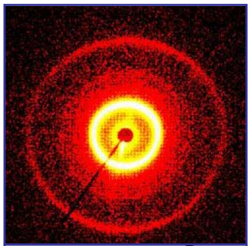
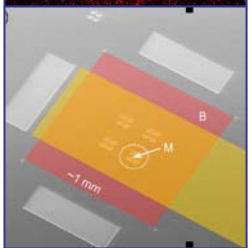
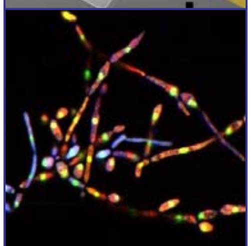
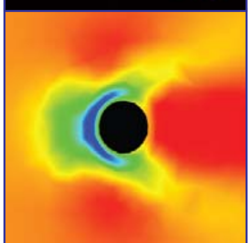
Surface Science **603** (2), 387-399 (2009)

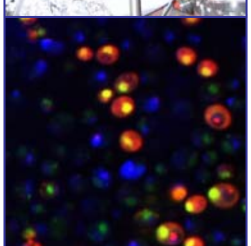
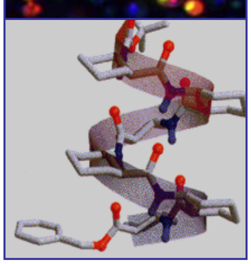


Potential energy surface (PES) for H2O adsorption and dissociation on Ga-terminated GaN(0001) surface in (2 _ 2) unit cell. TS indicates transition states; X(g) is species X in the gas phase, X* is species X adsorbed on the surface.

Abstract: In *in situ* NH_3 annealing procedure for the cleaning of GaN(0 0 0 1) is studied in detail using density functional theory (DFT), microkinetic modeling and X-ray photoelectron spectroscopy (XPS). The microkinetic model was calibrated and tested against published H_2 and NH_3 temperature programmed desorption (TPD) experiments on GaN(0 0 0 1). We find that an NH_3 treatment is efficient for the removal of carbon contaminants, but a complete removal of oxygen contaminants cannot be achieved. The remaining oxygen coverage after the treatment was estimated from XPS measurements to be 0.92 ML. In contrast, our microkinetic model based on DFT derived parameters predicts complete removal of OH species and a final oxygen coverage of 0.19 ML. We assign the difference between model and experiments to the formation of a surface oxide phase, which is not included in the model. DFT results also indicate strong adsorbate–adsorbate interactions for H, N, NH, NH_2, O, and OH on the GaN(0 0 0 1) surface which were incorporated into the microkinetic model to a first approximation. XPS experiments and microkinetic modeling demonstrate that the final surface composition shows little dependence on process parameters such as temperature or the time the sample is kept at an elevated temperature. Furthermore, the microkinetic model suggests that complete removal of OH from the surface can also be achieved using a NH_3/H_2 mixture, or even pure H_2 as a hydrogen source. The amount of H_2 present in the feed changes the coverage of NH_x species, but a certain amount of adsorbed oxygen is always left on the surface.

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6TVX-4V353YH-2&_user=443835&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000020958&_version=1&_urlVersion=0&_userid=443835&md5=eba0a3728ff1cfe8dc3415a82298b3a9

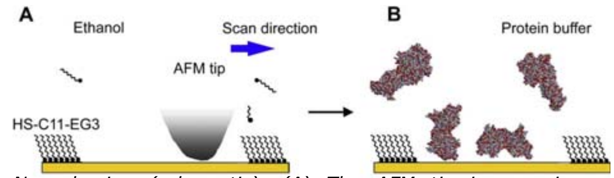





Positioning and guidance of neurons on gold surfaces by directed assembly of proteins using Atomic Force Microscopy

C. Staii, C. Viesselmann, J. Ballweg, L. Shi, G.-Y. Liu, J. C. Williams, E. W. Dent, S. N. Coppersmith, M. A. Eriksson

Biomaterials **30** (20), 3397-3404 (2009)



Nanoshaving (schematic). (A) The AFM tip is scanning a selected PEG/Au region at high force, effectively removing (shaving) the PEG SAM from this area. (B) The substrate is then immersed in a buffer solution containing the proteins (laminin or PDL), which adhere (physisorption) to the Au surface only onto the PEG-free (nanoshaved) region. The proteins schematic shows lysine monomers generated using protein data bank [31].PAA domains when the BCP template is exposed to the appropriate growth solution. c) Assembled directly from solution, the resulting large area arrays of nanocrystals replicate the pattern of the BCP template.

Abstract: We demonstrate that Atomic Force Microscopy nanolithography can be used to control effectively the adhesion, growth and interconnectivity of cortical neurons on Au surfaces. We demonstrate immobilization of neurons at *well-defined* locations on Au surfaces using two different types of patterned proteins: 1) poly-d-lysine (PDL), a positively charged polypeptide used extensively in tissue culture and 2) laminin, a component of the extracellular matrix. Our results show that both PDL and laminin patterns can be used to confine neuronal cells and to control their growth and interconnectivity on Au surfaces, a significant step towards the engineering of artificial neuronal assemblies with well-controlled neuron position and connections.

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6TWB-4VYW6BJ-2&_user=443835&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000020958&_version=1&_urlVersion=0&_userid=443835&md5=13c2a3253d977690f9cd82541f57655f

Size-dependent ordering of liquid crystals observed in polymeric capsules with micrometer and smaller diameters

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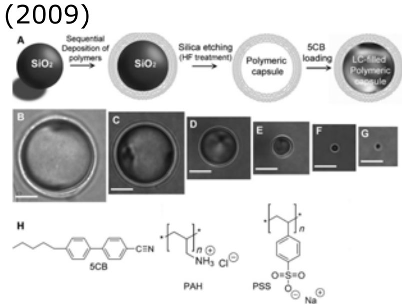
Angewandte Chemie International Edition **48** (9), 1652-1655 (2009)

Abstract: Made to order: Aqueous dispersions of polymer-encapsulated liquid crystal (LC) droplets were synthesized with precise interfacial chemistry and sizes in the micrometer-to-sub-micrometer range. Size-dependent changes in LC ordering could be observed. Study of the competition between size and interfacial chemistry on LC ordering enables size-dependent properties of LC droplets to be exploited in applications such as photonics and sensing.

http://www3.interscience.wiley.com/journal/121645026/abstract



A) Preparation of LC droplets of predetermined sizes within polymeric multilayer shells. Polymeric shells were prepared by sequential deposition of PSS and PAH onto silica templates and subsequent etching of the silica (see also Figure S1 in the Supporting Information). The resulting polymeric shells were filled with LCs. B–G) Bright-field micrographs of polymer-encapsulated 5CB droplets obtained using silica templates with diameters of 10_0.22, 8_0.20, 5_0.19, 3_0.18, 1_0.04, and 0.7_0.08 mm, respectively. The scale bars in all images correspond to 3 mm. H) Structures of molecules used in this study.

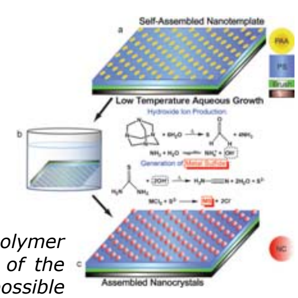
Assembly of nanocrystal arrays by block copolymer directed nucleation

S. A. Morin, Y. H. La, C.-C. Liu, J. A. Streifer, R. J. Hamers, P. F. Nealey, S. Jin

Angewandte Chemie International Edition **48** (12), 2135-2139 (2009)

Abstract: Growing in line: The surface chemistry of self-assembled nanostructured block copolymers is used to control the sites at which semiconducting metal sulfide nanocrystals nucleate and grow on a surface directly from aqueous solutions. This process is a new and general strategy for the bottom-up assembly of functional nanocrystalline materials for a variety of applications.

http://www3.interscience.wiley.com/journal/121684781/abstract



Direct assembly of metal sulfide nanocrystal arrays using self-assembled diblock copolymer nanostructures. a) Self-assembled PS-b-PAA nanostructures display loose hexagonal arrays of the PAA domains (yellow) when homogeneous brush layers (green) are used. Linear arrays are possible when chemically patterned brush layers are used (not shown). b) Selective nucleation and growth of desired metal sulfide nanocrystals (red) occur at the PAA domains when the BCP template is exposed to the appropriate growth solution. c) Assembled directly from solution, the resulting large area arrays of nanocrystals replicate the pattern of the BCP template.