

dered morphology of aligned core-shell cylinders.

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**Self Stratification in polymer blend films during spin-coating** — ●CHENG HUANG<sup>1</sup>, JÖRG PFEIFER<sup>1</sup>, STEFAN WALHEIM<sup>1</sup>, and THOMAS SCHIMMEL<sup>1,2</sup> — <sup>1</sup>Institute of Nanotechnology (INT), Northern Campus, Karlsruhe Institute of Technology (KIT) — <sup>2</sup>Institute of Applied Physics, Southern Campus, Karlsruhe Institute of Technology (KIT)

The phase separation process of PS/PMMA blend during spincoating from a Methy-Ethyl-Ketone (MEK) solution is studied. The polymer blend dissolved in this solution forms a purely lateral structure on a hydrophilic substrate with PS cylinders in PMMA matrix. Our results of time-resolved in situ reflectometry, post cast ellipsometry and SEM(scanning electron microscope) cross-sectional analysis point in the direction of a transient triplelayer formation during the spin-coating process which then transforms via an instability into the final lateral morphology. A purely horizontally layered situation in the dry state can also be tuned by process parameters. Humidity, spin rate and the concentration of the polymer blend solution are the most important parameters which define the final structure. The PS or PMMA phase was later selectively dissolved and the film was subsequently used as a lithographic Mask for further applications.

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**High Aspect Ratio Constructive Nanolithography with a Photo-Dimerizable Molecule** — MATTHIAS BARCZEWSKI<sup>1</sup>, ●ALEXANDER FÖRSTE<sup>1</sup>, STEFAN WALHEIM<sup>1</sup>, TOBIAS HEILER<sup>1</sup>, ALFRED BLASZCZYK<sup>1,2</sup>, MARCEL MAYOR<sup>1,3</sup>, and THOMAS SCHIMMEL<sup>1,4</sup> — <sup>1</sup>Institute of Nanotechnology (INT), Northern Campus, Karlsruhe Institute of Technology (KIT) — <sup>2</sup>Department of Commodity Science, Poznan University of Economics, Poland — <sup>3</sup>Department of Chemistry, University of Basel, Switzerland — <sup>4</sup>Institute of Applied Physics, Southern Campus, Karlsruhe Institute of Technology (KIT)

A major challenge in constructive nanolithography is the preservation of the lateral resolution of a monolayer-thick template pattern while amplifying it to a structure with a thickness above 10 nm. Our approach of photoinduced, constructive, reversible nanolithography, is based on nanografting within a coumarin-derivative thiol (CDT) solution using the tip of an atomic force microscope (AFM). By photodimerization and the formation of disulfide bonds, the CDT polymerizes in a single-step process. We demonstrate the highest lateral resolution in constructive nanolithography at thicknesses above 10 nm (40nm lateral resolution at 12 nm thickness, aspect ratio: 0.3).

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**Self-Alignment of Block Copolymers on Chemically Patterned Substrates** — ●TOBIAS HEILER<sup>1</sup>, ROLAND GRÖGER<sup>1</sup>, STEFAN WALHEIM<sup>1</sup>, and THOMAS SCHIMMEL<sup>1,2</sup> — <sup>1</sup>Institute of Nanotechnology (INT), Northern Campus, Karlsruhe Institute of Technology (KIT) — <sup>2</sup>Institute of Applied Physics, Southern Campus, Karlsruhe Institute of Technology (KIT)

Chemical patterns were made by nanoshaving polymer brush layers on silicon oxide. The contrast in polarity between brush surface and exposed silicon oxide was used to control the phase morphology of an amphiphilic block copolymer film. The two components of the block copolymer, as well as the surface of the chemically patterned substrate possess a high contrast in polarity, so that a defect tolerant pattern replication in the polymer film is observed after a short (vapor-)annealing process. Polybutadiene-based block copolymers and polystyrene brushes were used.

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**Influence of connectivity on the entropic stiffness of tethered membranes** — ●MARCO WERNER<sup>1,2</sup> and JENS-UWE SOMMER<sup>1,2</sup> — <sup>1</sup>Leibniz-Institut für Polymerforschung Dresden, Germany — <sup>2</sup>Technische Universität Dresden - Institute for Theoretical Physics

We investigate the static and dynamical properties of tethered structures like membranes and fractal polymer objects using the Bond-Fluctuation-Model in three-dimensional space. Tethered structures can be characterized by the spectral dimension depending on their connectivity. For two-dimensional polymers (perfect membranes) we confirm the picture of an entropic stiffness induced locally by excluded volume interaction, which in turn causes a flat state on larger scales [Y.Kantor and K.Kremer, *Phys. Rev. E* 48(4), 2490, (1993)]. On

the other hand we found fractal structures e.g. Sierpinski gaskets to be crumpled and their fractal dimension to agree with mean-field arguments [M.E.Cates, *Phys. Rev. Lett.* 53(9), 926, (1984)], whereas Sierpinski carpets are asymptotically flat like perfect membranes. Indeed we found mean field arguments to be self consistent for Sierpinski gaskets but not for Sierpinski carpets. Thus the lower critical dimension for tethered membranes might be below 2 as indicated by an  $\epsilon$ -expansion [J.A.Aronovitz and T.C.Lubensky, *Phys. Rev. Lett.* 60(25), 2634, (1988)].

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**Effect of chain architecture on microdomain orientation in thin films of block copolymer supramolecular assemblies** — ●BHANU NANDAN and MANFRED STAMM — Leibniz-Institut für Polymerforschung Dresden, Hohe Strasse 6, 01069 Dresden

The phase behaviour of supramolecular assemblies (SMA) formed by poly(4-vinylpyridine)-b-polystyrene-b-poly(4-vinylpyridine) (P4VP-b-PS-b-P4VP) triblock copolymer with 2-(4'-hydroxybenzeneazo)benzoic acid (HABA) was investigated with respect to the molar ratio (X) between HABA and 4VP monomer unit. The results were compared with SMAs formed by a PS-b-P4VP diblock copolymer of similar composition as the triblock but half the molecular weight to ascertain the effect of chain architecture on microphase separation. In bulk, both the di- and triblock SMAs showed composition dependent morphological transitions which could be tuned by HABA/4VP molar ratio. In thin films also, both the di- and triblock SMAs showed more or less similar morphological transitions depending on X. Interestingly, the domain orientation of the cylindrical or lamellar microdomains in the SMAs was influenced by the chain architecture of the block copolymer. After chloroform annealing whereas the diblock SMAs showed in-plane orientation of the domains, triblock SMAs showed perpendicular domain orientation. The perpendicular orientation of the microdomains in triblock was favored since it allowed the mid PS blocks to acquire normal distribution of loop and bridged conformations. \*This research was supported by the priority program of DFG (SPP1165, Project No. STA324/31).

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**High Density Magnetic Nanorods via Electrodeposition in Block Copolymer Thin Film Templates** — ●MARCUS BÖHME, BHANU NANDAN, and MANFRED STAMM — Leibniz-Institut für Polymerforschung Dresden e.V., Hohe Str. 6, 01069 Dresden

Recently, we presented a Nanotemplate based on the Supramolecular Assembly of poly-(styrene-b-4-vinylpyridine) with 2-(4'-hydroxybenzeneazo)benzoic acid[1]. One possible application of these templates is the creation of high density magnetic rod arrays to overcome the superparamagnetic limit in magnetic storage devices. Requirements for possible application are long range order and homogeneous filling of the individual pores.

Here, we present our results on increasing the long range order via solvent vapor treatment and filling the template pores with magnetic materials, e.g. cobalt, via electrochemistry. [1]A. Sidorenko, I. Tokarev, S. Minko, M. Stamm; *JACS* 125, 12211-12216, (2003)

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**Supramolecular assembly of poly(styrene)-b-poly(4-vinylpyridine) and 1-pyrenebutyric acid in thin film and their use for nanofabrication** — ●BIPLAB KUMAR KUILA and MANFRED STAMM — Department of Nanostructured Materials, Leibniz Institute of Polymer Research Dresden, Hohe Str. 6, D-01069 Dresden, Germany.

Block copolymer(BCP)based supramolecules are prepared by attaching small additive molecules in to the side chains of one of the BCP blocks1. BCP-based supramolecules also microphase separate similar to block copolymer into arrays of microdomains, tens of nanometers in size. Here, we have studied the supramolecular assembly of 1-pyrenebutyric acid(PBA)with PS-b-P4VP [Poly(styrene-block-(4-vinylpyridine)). The supramolecular assembly of PS-b-P4VP with PBA resulted the switching of block copolymer morphology from cylinder to lamella in thin film due to compositional change.PBA will make supramolecules with the P4VP block due to strong hydrogen bonding between the carboxylic group of 1-pyrenebutyric acid and pyridine ring of P4VP. After fabricating the thin film from the supramolecules, the minor component PBA can be easily removed by dissolving the thin film in ethanol to transform the block copolymer thin film into nanotemplate or membrane for practical application. We have also observed that these nanotemplates can be used for the fabrication of