DS 27: Micro- and Nanopatterning

Time: Wednesday 15:00–16:15 Location: H 0111

DS 27.1 Wed 15:00 H 0111

Reactive sputter deposition of vertically oriented metal nitride nanopillar arrays — •Thilo Richter and Zoe H. Barber — University of Cambridge, Cambridge, United Kingdom

We have developed a method for fabricating porous, nano-columnar metal nitride thin film structures. Reactive DC magnetron sputtering from elemental targets is used with parameters which promote the formation of inter-grain voids by minimising the energy of sputtered species. The resulting structures have a wide range of applications. Conductive titanium nitride films can be used as electrodes in batteries and fuel cells. Similar TiN nanopillar arrays have been heat treated to form titanium oxynitrides and ultimately semiconducting oxides. Photocatalytic pollutant degradation under visible light has been demonstrated as one possible application of such oxides. Furthermore, electrochemical deposition within the inter-grain voids can result in extremely anisotropic structures.

DS 27.2 Wed 15:15 H 0111

Pattern Guided Assembly and Inversion of Synthetic Opals — •Martin Waleczek[1], Jefferson Jean do Rosario[2], Josep M. Montero Moreno[1], Robert Zierold[1], Slawa Lang[3], Alexander Petrov[3], Manfred Eich[3], Gerold Schneider[2], and Kornelius Nielsch[1] — [1]Institute of Nanostructure and Solid State Physics, Universität Hamburg , Hamburg, Germany — [2]Institute of Advanced Ceramics, Hamburg University of Technology, Hamburg, Germany — [3]Institute of Optical and Electronic Materials, Hamburg University of Technology, Hamburg, Germany

The influence of a patterned template on the crystallization of an opal structure fabricated by means of vertical convective self assembly is studied. Lines, cubic arrangements as well as hexagonal structures with periodicities in the range of 300 - 900 nm are chosen as patterns and introduced by one-step or two-step UV laser interference lithography on top of a simple glass substrate. The synthetic opals are fabricated by vertical convective self-assembly on these defined patterns. After infiltration of the structure with a ceramic layer by Atomic Layer Deposition (ALD), the spheres are removed and the remaining inverse opal structure can be optically characterized.

We utilized FFT of Scanning Electron Micrographs to determine the resulting structure and quantify the degree of order depending on various deposition parameters. In this presentation, the influence of variations of the pattern periodicity on the crystallization of opal structures is highlighted and the results are related to optical measurements on the respective inverted opal structures.

DS 27.3 Wed 15:30 H 0111

Natural Curvature Induced Folding of an Elastic Film — •Octavio Albarran, Eleni Katifori, and Lucas Goehring — Max Planck institute for dynamics and Self-Organization, Gottingen 37077, Germany

The wrinkling and folding transitions of elastic films have been extensively studied in the last decade. The exchange of energy from stretching to bending acts as a paradigm for a wide range of elastic instabilities, including the wrinkling of the gut, and the crinkling of leaves. In two dimensions this type of problem is typically considered by the model of an elastica in compressive confinement. We show that, even without any external forces, an elastic surface supported by a fluid can bend and wrinkle when it acquires a non-zero natural curvature. Locally, we will demonstrate how a preferential curvature can be related to an effective compression, and hence a confining force that can vary spatially. This suggests a simple experimental setup, where we have characterised a variety of wrinkle patterns that can be generated for different mechanical properties and natural curvatures.

DS 27.4 Wed 15:45 H 0111

Alternate Multi-Polymer Nano Droplet Array on Topographically Structured Surfaces — Nandini Bhandaru, Anuja Das, Namrata Salunke, and •Rabibrata Mukherjee — Indian Institute of Technology Kharagpur, Kharagpur, India

Submicron scale surface morphologies comprising of ordered multimaterial domains find various applications in fabrication of multifunctional coatings, development of exotic metamaterials, high resolution microscopy etc., but these structures are still scientifically more challenging to fabricate. We have developed a novel method for creating alternate equi-sized binary polymer nano domains using sequential spin dewetting of polymethylmethacrylate (PMMA) and polystyrene (PS) solutions on topographically patterned substrates. Polymer solutions with concentrations as low as 0.1% (w/v) when spin coated over a non wettable substrate undergoes in-situ de-wetting during the coating process itself, by a phenomenon also known as Spin De-wetting. This phenomena, along with intermediate substrate silanizaton with octadecyl-trichloro-silane (OTS) results in a multi material droplet array. The formation takes place for range of solution concentration of both polymers and on a variety of substrate geometry leading to creation of a multifunctional surface.

DS 27.5 Wed 16:00 H 0111

Phase Segregated Domains of Polymer Blend Thin Films: Effect of Molecular Weight, Surface Energy and Topographic Confinement — •Nandini Bhandaru and Rabibrata Mukherjee — Indian Institute of Technology Kharagpur, Kharagpur, India

The phenomenon of spontaneous phase segregation of an immiscible polymer blend system is a major area of research as these surfaces can be potentially leveraged in a wide variety of applications like as templates in tissue engineering, organic solar cells, etc. Spin cast films of these blends show a variety of random structures depending on the composition of the two polymers, the film thickness as well as the nature of the substrate. In this work, poly(styrene) (PS)-poly(methylmethaacrylate) (PMMA) blend thin films of various concentrations and compositions were spin coated on flat as well as on different topographically patterned substrates and the phase segregated morphology all the cases are compared. Multiple parameters including the molecular weight of the polymers, the surface energy of flat and patterned substrates and nature of the topographic confinement were varied to obtain highly ordered multi-material nano structures. Also, the presence of patterns result in a certain reduction in the domain size for each of polymer component.