

**AN ATOMIC FORCE MICROSCOPY STUDY OF SURFACE  
STRUCTURES OF COLLOIDAL  $\beta$ -FeOOH CRYSTALS FORMING  
SMECTIC LAYERS AND CRYSTAL SIZE EVALUATION WITH  
ELECTRON MICROSCOPE**

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Rod-like Colloidal Crystals of  $\beta$ -FeOOH with a square cross section (140-420 nm in length and 20-110 nm in width) were prepared from ferric chloride solutions. The crystal dimensions and the distributions were measured as a function of temperature, ferric chloride concentration, and age of the solutions using TEM, and the surface structures of the crystals were investigated using AFM. The results from TEM images for the crystals are as follows, (1) The dimensions (showing significant narrow distributions) decreased as the solution temperature increased. With increasing ferric chloride concentration, the length showed a maximum value at around 20 mM at a solution temperature of 15°C. The resulting aspect ratios showed an increase with increasing ferric chloride concentration and decreasing solution temperature. (2) The dimensions of the crystals growing in ferric chloride solutions at 15°C were measured for a period of 30-290 days. The measured lengths were found to be fittable with a linear combination of sigmoidal and linear curves. Smectic layers spontaneously appeared over a wide area from evaporating droplets of the  $\beta$ -FeOOH crystal suspensions on glass substrates. AFM surface images of the crystals forming the smectic phase showed various shapes of islands with a minimal step-height of 1.09 nm but no spiral steps due to line dislocations, suggesting that the crystal growth process consists of two dimensional nucleus formation and subsequent lateral growth of molecular layers on the crystal surfaces.

**Keywords: AFM  $\beta$ -FeOOH-CRYSTAL SMECTIC-STRUCTURE**

**MORPHOLOGICAL PATTERNS IN POLYSTYRENE /  
POLYISOPRENE BLEND FILMS CAST ONTO HYDROPHOBIC AND  
HYDROPHILIC SUBSTRATES.**

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Morphology of thin polymer blend films strongly depends on the conditions of spin-casting SC and is crucial for the performance of various applications. This motivated numerous studies, where AFM data were analysed only by Fourier analysis. Very recently a novel approach of integral geometry IG [1,2] has been introduced, which characterises also the size, shape and density of morphological features. In this study we have extended IG approach to characterise morphology of each AFM image merely by a set of a few values. We have performed systematic AFM studies of model blend films [3-5] of (deuterated) polystyrene/ polyisoprene PS/PI with different PI mass fraction ( $m_{PI}=0.05-0.95$ ) spin-cast from toluene onto hydrophobic- and hydrophilic-Self-Assembled Monolayers SAM. Surface undulation were observed with elevated and lower plateau regions, corresponding to PS- and PI-rich domains, respectively [4]. Structures with separated hole-like domains evolved with mPI into bicontinuous morphology and then into patterns with dispersed island-like regions. For hydrophilic SAM substrate the bicontinuous morphology was observed for higher  $m_{PI}$  value. Applied IG [1,2,5] extension not only proved to be a valuable tool in morphology characterisation but also allowed us to relate various morphologies with different regimes of phase separation process.

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**Keywords: AFM, THIN POLYMER FILM, MICROSTRUCTURES CHARACTERIZATION**

**STRUCTURES OF THE INITIAL ADSORBED LAYERS OF STEARIC  
ACID AT LIQUID/SOLID INTERFACE**

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To understand epitaxial crystal growth of organic molecules from solutions, the most important subject is to examine formation processes of the first monomolecular layer at liquid/solid interface. However, sometimes the second and successive few layers play an essential role in further epitaxial growth because the structure of adsorbed layer is relaxed into a stable one. In this study, structural aspect of the first and second layers of stearic acid was analyzed by STM in a solution.

A droplet of stearic acid in octylbenzene solution (1.7 mM) was placed on a freshly cleaved graphite (0001) surface. An STM probe (Pt/Ir) was directly inserted into the droplet and the two-dimensional crystal at the liquid/solid interface was observed. As for the first layer, STM images exhibit a new structure ( $\alpha$ -form), which is covered by the second layer with the known  $\beta$ -form. Although the molecular stacking axis (column axis) of the second layer does not orient along that of the first layer, the directions of the alkyl chains are coincident with each other. The  $\alpha$ -form is concluded to be a pseudo structure that is observed only as the first layer on the graphite surface. After that, the  $\alpha$ -form changes into the more stable  $\beta$ -form during the growth.

**Keywords: EPITAXY RELAXATION STM**

**PHOTOLUMINESCENT PROPERTIES OF THE NATURAL AND  
SYNTHETIC COLOURED DIAMONDS**

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Samples of natural (Yacutian) and synthetic (Russian produced) diamonds of various colour (colourless, blue, green, yellow, brown, pink, red) were investigated by means of laser induced photoluminescence. Among investigated samples there were several octahedral natural diamond crystals (brown), synthetic diamond crystals (yellow, greenish-yellow), flat plates cut from natural and synthetic diamonds (colourless, yellow, green, brown), and natural and synthetic round cut (produced for jewellery purposes) diamonds (colourless, yellow, pink, red, green, blue). Colour of several samples (natural octahedral diamond crystal) was artificially changed by annealing at the temperatures of 1700-1800°C under high pressure (6 GPa) and colour of some samples (octahedral natural diamond crystals, natural and synthetic diamond flat plates) was changed by the irradiation by protons with or without subsequent annealing at the temperatures up to 2000°C. For our investigation we have chosen several spectroscopic methods such as laser induced (lasers with wavelengths of 488 nm and 514.5 nm) photoluminescence (at the room and liquid nitrogen temperature), and also additional methods: visible and infrared range absorption spectroscopy (at the room temperature), EPR spectroscopy. For annealed and irradiated samples spectroscopic data was gained before and after annealing or irradiation. Acquired data provide a useful information on causes of diamond colour, mechanism of the transformation and stability of lattice defects in diamonds.

**Keywords: DIAMOND, DEFECT, SPECTROSCOPY**