CPP 5: New Instruments and Methods

Time: Monday 10:15–11:15 Location: H39

CPP 5.1 Mon 10:15 H39

Investigation of hybrid nanostructures using AFM/STM based on tuning fork sensors — •Inshad Jum'h, Viatcheslav Dremov, Yuri Koval, and Paul Müller — Department of Physics and Interdisciplinary Center for Molecular Materials (ICMM), Universität Erlangen-Nürnberg

We present a combination of non-contact AFM and STM using a sharp etched metal tip and a quartz tuning fork as the force sensor. This method has proven to be stable at ambient conditions and provides high-resolution images of topography, conductivity, force gradient and dissipated power simultaneously. This is suitable for conductive, partially conductive and nonconductive materials. In this work, we study a variety of nanostructures and map the conductivity of various hybrid materials. We present our recent results for the graphitized layer of polymer surfaces modified by low energy ion beam irradiation. We demonstrate the possibility to study composite materials based on few layered graphite (FLG) using this method.

CPP 5.2 Mon 10:30 H39

Nanomechanical characterization of fibrillar structures — •Daniel Kluge and Andreas Fery — Department of Physical Chemistry II, Universität Bayreuth, Universitätsstraße 30, 95440 Bayreuth, Germany

Micro- and nanofibers have become increasingly important in materials sciences as there are many diverse applications for tissue engineering, filtration and in composite materials. The most fundamental requirement for all of these applications is a suitable mechanical stability. In order to investigate the mechanical properties of small-scale fibers, approaches beyond standard characterization methods for macroscopic materials are necessary. Recently, we studied the nanomechanical properties of self-assembled 1,3,5-tris(2,2-dimethylpropionylamino)benzene fibers. For that purpose, we developed a new approach on AFM bending experiments that used force mapping to acquire spatially resolved force measurements over the full length of a free standing fiber segment. This allowed us the validation of the experimental boundary conditions directly from the AFM data and a reliable determination of Young's modulus. In this contribution, we will present our technique and discuss its application for other fibrillar systems.

CPP 5.3 Mon 10:45 H39

Temperature Measurements within a Laser Heating Process on Polymer Films — •Ralf S. Kappes[1] and Jochen S. Gutmann[1,2] — [1]Max Planck Institute for Polymer Research, Mainz, Germany — [2]Joh.-Gutenberg University, Mainz, Germany

There are multiple ways of measuring temperatures nowadays. Still the task of detecting high temperatures, i.e. around 1000 Kelvin with a microsecond time and a micrometer size resolution is quite challenging. However, the temperature is an important factor if it comes to the understanding of processes which proceed in those orders of magnitude, like for example laser heating on polymer films. To achieve this goal we set up an optical detection system using high performance optics and a microsecond gated camera in combination with various interference filters to detect the thermal emission spectrum in the Vis range. Analyzing the radiation data via a fit of Planck's law to the obtained curve we are finally able to collect a 2D temperature profile for time intervals as short as one microsecond within a process. In this way we can show, that a polymer film, which is doped with an organic dye for energy conversion, can reach temperatures of at least 900 Kelvin, which is high above its "normal" decomposition temperature, determined e.g. from thermogravimetric methods. And it is furthermore possible for us to achieve a relation between the temperature in process and the effect on the polymer film afterwards.

CPP 5.4 Mon 11:00 H39

Hyperspectral CARS imaging of polyolefine deformation — •Gregor Hehl[1], Gulnara Yu. Nikolaeva[2], Stefan Gomes da Costa[1], and Andreas Volkmer[1] — [1]3rd Institute of Physics, University of Stuttgart — [2]RAS, Moscow, Russia

We report on the hyperspectral coherent anti-Stokes Raman scattering (CARS) imaging of the initial stages of polyolefine deformation. Many polyolefines undergo uniaxial stretching with formation of a so-called necking region where the axes of most of the macromolecules become oriented along the direction of deformation [1]. To investigate the structural changes of macromolecular orientation without perturbing the polymer structure of interest, labelfree hyperspectral CARS imaging [2] of polyethylene and isotactic polypropylene was performed. Spectral CARS hypercubes providing both spectral and spatial information of the polymers for each image voxel have been collected with 5-cm-1 and sub-micron resolution, respectively. Based on the corresponding phase-retrieved Raman hypercube using the Maximum Entropy method [3] and on the characteristic Raman bands of the polymers, hyperspectral data processing results in pseudo-color images of the degrees of molecular orientation and of crystallinity. Unlike conventional X-ray measurements, IR and Raman microspectroscopies, we demonstrate unprecedented fast 3D chemical mapping of local physical structure information of polymers with high spatial resolution and at high spectrum acquisition rate. [1] S. A. Gordeev et al., Polymer Science, Ser. A 38 (1996), 517, [2] A. Volkmer, J. Phys. D: Appl. Phys. 38 (2005), R59, [3] E. Vartiainen et al., Appl. Spectrosc. 50 (1996), 1283.