CPP 31 Polymer physics: special techniques

Zeit: Mittwoch 09:45–11:00 Raum: TU C130

CPP 31.1 Mi 09:45 TU C130

Scattering-type near-field infrared microscopy of selforganized nanodomains of diblock copolymers — •M. B. Raschke[1], L. Molina[1], K. Hinrichs[2], D. H. Kim[3], and W. Knoll[3] — [1]Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie, D-12489 Berlin — [2]ISAS - Institute for Analytical Sciences, D-12489 Berlin — [3]Max-Planck-Institut für Polymerforschung, D-55128 Mainz

The expansion of scattering-type scanning near-field optical microscopy (*s*-SNOM) into the infrared spectral region currently emerges as a promising technique due to its ability to achieve all-optical resolution down to the several nanometer range in combination with the chemical sensitivity provided by infrared spectroscopy. Here, we have performed a nanometer scale surface analysis and identification of domains formed by phase separation of the diblock copolymers polystyrene-*b*-polyvinylpyridine (PS-b-P2VP) and polystyrene-*b*-polyethyleneoxide (PS-b-PEO). This has been achieved by means of non-interferometric IR-scattering detection based on epi-illumination of sharp Au-coated cantilever tips in a noncontact atomic force microscopy configuration. Probing at 3.39 μm (2950 cm^{-1}) contrast is obtained due to differences in the spectral position of the C–H stretch vibrational resonances for the two polymer constituents and their local density. The mechanism of the near-field tip-sample coupling by vibrational resonances responsible for the imaging contrast has been deduced and can be modelled based on the dielectric functions of the polymer compounds measured by spectroscopic ellipsometry.

CPP 31.2 Mi 10:00 TU C130

THE USE OF MICROFOCUS SYNCHROTRON X-RAY RADIATION AS A NOVEL TECHNIQUE TO STUDY THE INTERFACE IN COMPOSITES — •Konrad Schneider[1], Nikolaos Zafeiropoulos[1], Richard Davies[2], Manfred Burghammer[2], and Manfred Stamm[1] — [1]Institut fuer Polymerforschung Dresden, Hohe Str. 6, 01069 Dresden — [2]European Synchrotron Radiation Facility (ESRF) ID13 Beamline, BP 220, F-38043, Grenoble, France

It has been well established that the strength and toughness of fibre-reinforced materials are determined to a great extent by the interface between the reinforcing fibres and the matrix. In the present study we present a novel and very powerful technique based on small angle x-ray scattering (SAXS) to study the interfacial mechanisms of failure in the range of nm. The scattering of x-rays is caused by the difference in the electron density of domains inside the material. In the case of interfacial failure of composites there is an increased number of micro cracks, voids, and debonded areas in which the density is much lower than it is in the undamaged regions. The ID 13 beamline at ESRF, Grenoble enables experiments with a brilliant beam and a spot of about 5 microns. In a multi-fibre epoxy/glass model composite, subjected to the fragmentation test, as well as in a single fibre composite the method is presented in static as well as online mode. The composites were scanned around the optically visible fibre fragments. One may clearly see the areas with a high density of voids, through the higher intensity of the scattered x-rays. The actual state of quantifying this series of patterns to extract the geometrical dimensions and shape of these voids is presented.

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Exact cutoff techniques in supercell calculations — •Carlo Andrea Rozzi[1], Angel Rubio[2], and Eberhard K.U. Gross[1] — [1]Freie Universität Berlin — [2]Donostia International Physics Center (DIPC)

TDDFT has been shown to be an excellent approach to correctly and efficiently describe excited states in atoms and molecules. Yet, when applied to infinite periodic systems, both conceptual and implementational problems arise. Among them the question whether or not it is possible to describe a bound exciton in infinite periodic systems using pure TDDFT is still not completely answered. This problem is particularly challenging in systems that are periodic in less than three dimensions, like polymers and nanotubes (1D periodic), or surfaces and thin films (2D periodic). Such systems are usually treated in a supercell approach, as a three dimensional array of chains or slabs, and the computational cost for the simulations dramatically increases with the cell size. Moreover, due to the long range character of the Coulomb interaction, the equivalent isolated system (i.e. the single chain or film) is exactly described only in the limit of an infinite supercell. This has lead to the request for efficient techniques to cut off the Coulomb interaction in systems with reduced periodic dimensionality. We will show how to calculate exact analytical cutoffs to properly screen at a desired extent the long range Coulomb interaction in both 1D and 2D systems. This allows one to compute most efficiently the properties of the infinite system alone to compare them with those of the system plus its periodic images.

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Messung und Modellierung röntgeninduzierter Brechungsindexänderungen in Polymethylmethacrylat* — •Ingo Breunig, Birk Andreas und Karsten Buse — Physikalisches Institut, Universität Bonn, Wegelerstr. 8, 53115 Bonn

Mit Hilfe räumlich modulierter Röntgen-Bestrahlung können in Polymethylmethacrylat (PMMA) gezielt Brechungsindexstrukturen erzeugt werden. Eine mögliche Anwendung ist die Herstellung integriert-optischer Komponenten. Um beliebige und zeitlich stabile Brechungsindexmuster zu erzeugen, ist es notwendig, die strahlungsinduzierten Prozesse zu verstehen und quantitativ zu beschreiben. PMMA-Proben werden weicher Röntgen-Strahlung ausgesetzt. Interferometrische Verfahren zeigen Brechungsindexerhöhungen an der Probenoberfläche und Brechungsindexverringerungen in einigen Millimetern Tiefe. Die erzielten Brechungsindexänderungen betragen einige 10^{-4}. Sie sind abhängig vom Bestrahlaufwand also von der im Material abgelagerten Dosis. Weiterhin wird eine temperaturabhängige Entwicklung der Brechungsindexänderungen in der Zeit nach der Bestrahlung beobachtet. Ein Modell auf der Basis der Clausius-Mosotti-Gleichung kann die Brechungsindexänderungen durch die strahlungsinduzierte Änderung der Dichte und der chemischen Zusammensetzung quantitativ erklären.

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High refractive index hybrid materials for two-photon polymerization for photonic applications — •Pelagie Declerck[1], Ruth Houbertz[1], Gerhard Domann[1], Carsten Reinhardt[2], and Boris Chichkov[2] — [1]Fraunhofer-ISC, Neunerplatz 2,97082 Würzburg — [2]Laserzentrum Hannover LZH, Hollerithallee 8, 30419 Hannover

High refractive index inorganic-organic materials were synthesized by hydrolysis/condensation reactions. One or two-photon polymerization processes were applied to organically cross-link the resin. While the resins have to absorb around 365 nm for UV lithography, they have to be transparent near 800 nm for the 2PP process. The latter process allows one to write 3D structures down to the nm scale and at ultra-fast speed. This can be applied for the generation of photonic elements.

In order to increase the refractive index, an in-situ synthesis was developed which links organoalkoxysilane precursors containing UV polymerizable groups and titanium-based precursors. The influence of two different organoalkoxysilane on the resulting optical properties was studied. The properties of the hybrid materials and the resulting layers were investigated. Besides, experiments on the technological processing of the resins were carried out in order to determine their ability to be patterned by UV light and by 2PP processes. The refractive index of the layers was checked after a final curing step at 150°C. Transparent and high refractive index coatings were obtained (1.8 at 1820 nm).