DS 18: Layer Properties: Electrical, Optical and Mechanical Properties II

Time: Wednesday 11:15–12:30 Location: GER 37

DS 18.1 Wed 11:15 GER 37

Switchable electro-optical properties of chromophore/ polymer/ metal nanocomposites near the percolation threshold — •Christina Pakula[1], Christian Hanisch[1], Vladimir Zaporojtchenko[1], Thomas Strunskus[1], Franz Faupel[1], and Rainer Herges[2] — [1]Materialverbunde, Institut für Materialwissenschaft, CAU Kiel, Kaiserstr. 2, 24143 Kiel — [2]Otto Diels-Institut, CAU Kiel, Otto-Hahn-Platz 3/4, 24118 Kiel

Chromophores are under interest nowadays because of their light induced conformational change leading to e.g. a higher dipole moment. Inside a polymer matrix the isomerization leads to switchable changes in the physical properties. The optical switching of two different azobenzene ethers dissolved in a PMMA matrix in combination with a 2D nanoparticle gold array were studied. These may be used as light switchable sensors. The chromophore/polymer film was prepared by spin-coating. The metal clusters were deposited either by thermal evaporation or sputtering. Different mixing ratios of PMMA and the two azobenzene ethers and their absorption behaviors in the UV/Vis region have been examined. The new azobenzene ether with a branched side chain had a higher absorption at the same conditions and filling factors than the first azobenzene ether. Furthermore there was no separation of polymer and azobenzene ether with the second molecule. Also the time dependencies of the switching behavior exposed to UV and visible light and the influence of the gold clusters on the switching times were examined. Finally the photoswitchable changes in resistance of the 2D-Au nanocomposite films will be discussed.

DS 18.2 Wed 11:30 GER 37

From cross-linked self-assembled monolayers to nanosheet multilayers — •Christoph T. Nottbohm, Andrey Turchanin, Andre Beyer, and Armin Gölzhäuser — Fakultät für Physik, Universität Bielefeld, Postfach 10 01 31, 33501 Bielefeld, Germany

Self-assembled monolayers of biphenylthiol on gold substrates have been cross-linked by electron irradiation resulting in the formation of nanosheets with a thickness of ∼1 nm. They have been released from the original substrate by etching and transferred to new substrates such as oxidized Si-wafers or transmission electron microscopy (TEM) grids. Transfer of multiple nanosheets onto the same substrate allows the preparation of nanosheet multilayers. Annealing at temperatures of up to ∼1200 K in ultrahigh vacuum leads to structural changes in the multilayers. These were systematically studied for different annealing temperatures and thicknesses ranging from ∼1 nm to ∼5 nm with the aid of x-ray photoelectron spectroscopy (XPS), UV/Vis spectroscopy and electrical 4-point measurements.

DS 18.3 Wed 11:45 GER 37

Freestanding nanomembranes with adjustable stiffness from self-assembled monolayers — •Xianghui Zhang, Christoph T. Nottbohm, Andrey Turchanin, Andre Beyer, and Armin Gölzhäuser — Fakultät für Physik, Universität Bielefeld, Postfach 10 01 31, 33501 Bielefeld, Germany

We report on the fabrication and mechanical characterization of novel nanomembranes with a thickness of approximately 1 nm, whose stiffness is adjustable by an annealing treatment. The nanomembranes are prepared from electron cross-linked aromatic self-assembled monolayers (SAMs). Subsequent etching of the supporting substrate and transferring to window-structured substrates provides freestanding nanomembranes. Bulge testing within an atomic force microscope (AFM) is utilized to investigate their mechanical properties. To determine the Young's modulus, the deformation of a nanomembrane is measured after applying a pressure to one side. Pristine membranes display elastic moduli ranging from 8 to 12 GPa, which are adjustable by the electron dose. After a thermal treatment in ultra high vacuum (UHV) they show a higher mechanical stiffness. Annealing gives rise to a systematic increase of the Young's moduli from ∼10 GPa to ∼45 GPa for an annealing temperature of ∼1000 K. Strain relaxation lowers the residual strain from 0.9 % to ∼0.35 % for temperatures of 800 K and above. This indicates that the relevant structural transformation is completed at that temperature.

DS 18.4 Wed 12:00 GER 37

Mechanical stress impact on thin film thermodynamic properties - investigated by hydrogen loading — •Stefan Wagner and Astrid Pundt — Institut für Materialphysik, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

Thermodynamic properties of thin films deviate strongly from those of bulk. The deviations are reported to originate from microstructure and from mechanical stress, while the contribution of both is unknown in particular. Focussing on the mechanical stress impact and applying PdHx and PdyFe1-yHx as model systems, it is shown that mechanical stress strongly changes phase transition pressures. Hydrogen absorption and hydride formation are monitored by in situ four point resistance measurement. For PdHx films the hydride formation pressures shift up to 400 mbar in contrast to 18 mbar for bulk. These shifts relate to the films adhesion to the substrate and can be affected by film detachment. It will be shown that freestanding PdHx films down to 30 nm film thickness behave bulk-like.

DS 18.5 Wed 12:15 GER 37

Mechanical characterization of glancing angle deposited Si Nanostructures — •André Miessler[1], Christian Patzig[1], Bernd Rauschenbach[1], and Bodo Fuhrmann[2] — [1]Leibniz Institute of Surface Modification, Permoserstraße 15, 04318 Leipzig, Germany — [2]Martin-Luther-Universität Halle, Heinrich-Damerow-Straße 4, 06120 Halle, Germany

In physical vapour deposition processes the incoming particle flux strikes perpendicular to the surface, whereas a compact film is deposed on the substrate. However, at the glancing angle deposition (GLAD) process the sample is tilted with respect to the substrate normal, so the particle flux strikes the surface under an highly oblique angle β (typically $\beta > 80°$ with respect to the substrate normal). Self-shadowing of the deposed particles lead to a non-closed and highly porous film, which is compose of needle-like nanostructures, toward the incoming particle flux. By means of substrate rotation, different structures such as pillars, zigzags, screws or spirals can be obtained.

Although in recent years a series of fundamentally findings have been published, mechanical properties remain unknown. Our goal was to determine the mechanical properties (such as hardness, Young's Modulus and spring constants of spiral structures) by employing nanoindentation with a flat punch to these 3D silicon nanostructures.