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Hörsaal C, Chemie Zentralbau, 17:15 Uhr

Sprecher: Marcel Mayor
Universität Basel

Thema: Supramolecular Systems at Various Dimensions: from single molecule junctions to nanoscale objects

Abstract:

Supramolecular interactions between well defined molecular building blocks enabled the formation of complex and functional nanoscale architectures.

In a recent project we strive towards synthesizing mechanically interlinked supermolecules and we hope to be soon able to investigate transport properties and mechanical features on a single molecule level in a molecular junction.

Beyond well defined relatively small molecules, the dimensional requirements of nanoscale objects moved macromolecular structures into the focus of interest.

Inspired by the pioneering work of Robin Nicholas[1] the ability of various polymers to disperse single walled carbon nanotubes (SWCNTs) was investigated. Interestingly subtle structural variations of the polymer alter the composition of the dispersed SWCNTs considerably. For example poly(N-decyl-2,7-carbazole) as structural proxy of poly(9,9-didecyl-2,7-fluorene) disperses mainly semiconducting SWCNTs with chiral angles smaller than 22° , while the fluorene polymer prefers chiral angles larger than 22° [2]. In order to combine selectivity features of structural subunits co-polymers moved into the focus of interest. An alternating co-polymer consisting of 1,5-anthracene and 2,7-fluorene subunits dispersed exclusively SWCNTs with diameters larger than 0.9 nm [3]. To investigate the correlation between the polymers structure and the dispersed SWCNTs more systematically an entire library of co-polymers was synthesized and the dispersion features of its components were analyzed [4]. The stability of the dispersed polymer/SWCNT complex depends on the polymers length as displayed with polymer exchange reactions using oligomers of well defined length [5]. The reduced dispersion ability of short polymer fractions also enabled the reversible dispersion of SWCNTs. Introduction of a photo-cleavable subunit in the polymer backbone allowed the release of the SWCNTs upon UV excitation [6]. We are currently working on polymers displaying improved selectivity features comprising functional properties enabling the further processing of the dispersed SWCNTs.

In a second approach we are seeking for macromolecules able to coat inorganic particles and thereby removing them from the reaction mixture during their growth. With this approach coated particles with narrow size distribution and an organic coat controlling their exposed functional groups are obtained. Oligomeric benzylic thioethers as multi-dentate ligands displayed favorable properties for the stabilization of gold nanoparticles. A heptameric structure stabilized particles with diameters around 1 nm and the dimensional comparison pointed at a ratio of only two ligands per particle [7]. By further functionalizing the

coating ligand, the integer relation of ligands per particle allowed to control the number of peripheral functional groups. For example particles exposing two protected ethynyl-functions at opposed sites were synthesized and subsequently interlinked by oxidative acetylene coupling protocols [8]. A perpendicular arrangement at the particles surface of the ethynyl-function bearing molecular rod was obtained by introducing a coordinating pyridine subunit [9]. In order to expand the surface coating of the macromolecular structure, a dendritic design was investigated. The icosadentate second generation dendrimer turned out to efficiently coat and stabilize gold nanoparticles with diameters around 1.2 nm [10]. The 1/1 ratio of coating ligand per gold nanoparticle made monofunctionalized particles available. The corresponding ethynyl-functionalized particles provided exclusively dumbbell type dimers as organic/inorganic hybrid architectures assembled by wet chemistry [11]. Our current investigations are geared towards expanding the scope of applicable coupling chemistry and varying the nanoparticles (dimensions and materials).

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Organisation: F. Würthner

Kontakt: Prof. Dr. Tobias Brixner, Institut für Physikalische und Theoretische Chemie,
brixner@phys-chemie.uni-wuerzburg.de

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