Experimental report

30/03/2021

Proposal: 9-10-1253 **Council:** 4/2017

Title: Supramolecular Organic-Inorganic Hybrid Nanoparticles

Research area: Chemistry

This proposal is a new proposal

Main proposer: Franziska GROEHN

Experimental team: Franziska GROEHN
Giacomo MARIANI

Local contacts: Ralf SCHWEINS

Samples: C,H,S,O, N, Cl, Na, B, Au: PAMAM dendrimers, dye molecules and gold colloids dissolved in D2O

Instrument	Requested days	Allocated days	From	To
D11	3	2	15/11/2012	17/11/2012
D22	3	0		

Abstract:

Aim of this project is to investigate the structure of novel organic-inorganic hybrid nano-assemblies in aqueous solution by SANS. Organic-inorganic hybrid nanostructures are of importance as they combine advantageous properties of both components. In nanotechnology, it is of importance to organize metal or semiconductor nanoparticles. To do so, self-assembly represents a versatile route. We have established a new concept of electrostatic self-assembly for the formation of organic supramolecular nanoscale assemblies of various shapes in aqueous solution. It is now highly promising to exploit this concept to supramolecular nanostructures for the formation of organic-inorganic hybrid assemblies. Specifically, this will be ternary dendrimergolddye nanocomposites. Complementary to transmission electron microscopy (TEM) which has elucidated the metal nanostructure, SANS will reveal the assembly shape in solution, providing a complete picture necessary to establish the concept as versatile route to novel hybrid nanostructures.

Experiment 9-10-1253

Electrostatic Self-Assembly Supramolecular Organic-Inorganic Hy brid Nanoparticles

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Complementary to transmission electron microscopy (TEM) which has elucidated the metal nanostructure, SANS revealed the assembly shape in solution, providing a complete picture necessary to establish the concept as versatile route to novel hybrid nanostructures.

Specifically, we present a novel, self-assembled nanostructure with selective photocatalytic activity formed from anionic polyoxometalate clusters and cationic dendrimers by electrostatic self-assembly. The association of the components in aqueous solution is driven by ionic interaction and steric factors yielding stable aggregates of a defined size with a coil-like structure. The assemblies show high potential for the application in solar-energy conversion systems due to their enhanced and substrate specific photocatalytic activity

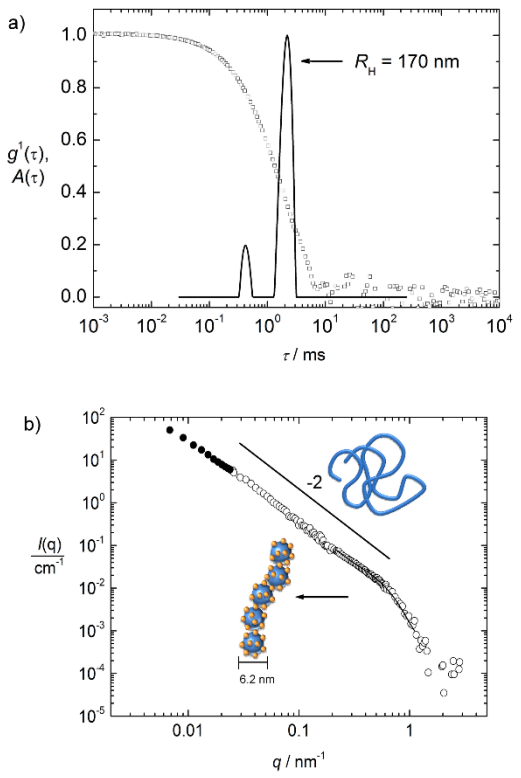


Fig 1 Scattering characterization of POM-dendrimer assemblies: a) Dynamic light scattering: electric field autocorrelation function $g^1(\tau)$ and distribution of relaxation times $A(\tau)$ for POM-dendrimer assemblies with I = 0.7; b) Static light scattering and SANS of POM-dendrimer assemblies with I = 0.7; filled symbols: SLS data points, open symbols: SANS data points, black line at high q: flexible cylinder fit; SLS, DLS: c(dendrimer) = $1.69 \cdot 10^{-5}$ mol L^{-1}; SANS: c(dendrimer) = $3.52 \cdot 10^{-5}$ mol L^{-1}.[1]

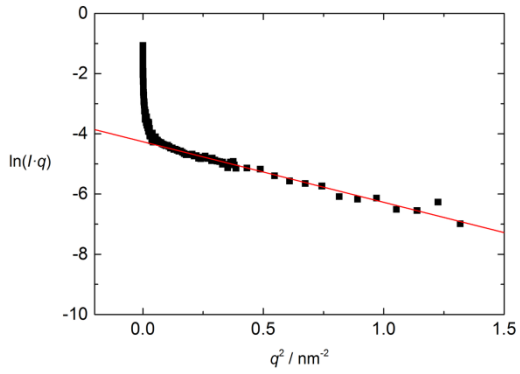
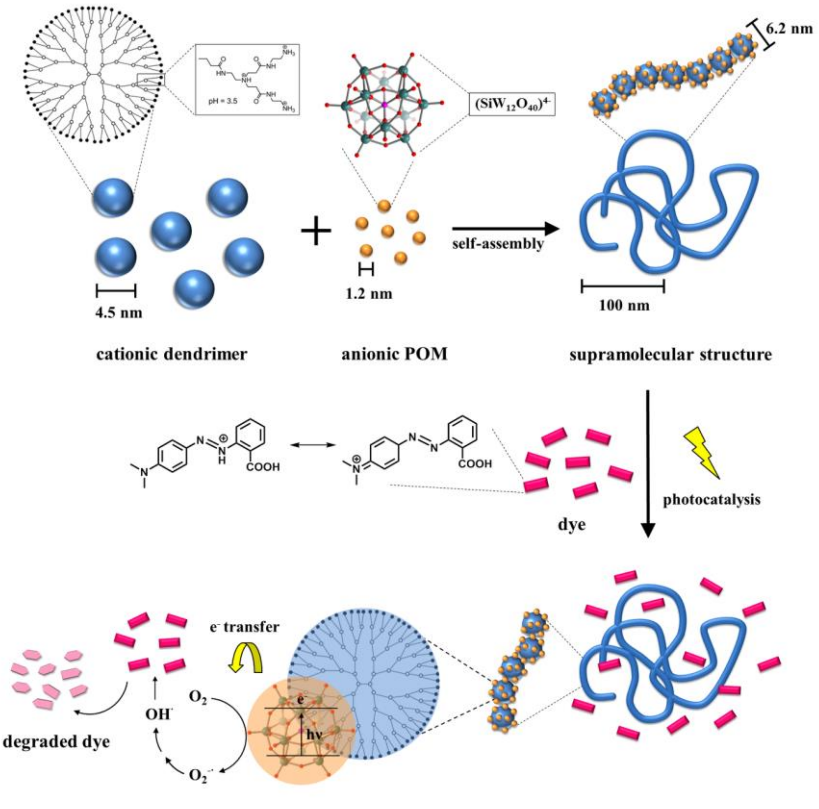


Figure 2: Cross-section Guinier plot of SANS data of POM-dendrimer assemblies with $I = 0.7$ and c(dendrimer) = $3.52 \cdot 10^{-5}$ mol L^{-1}: the linear dependence indicates locally cylindrical structures. [1]



activity.

Scheme 1. Schematic representation of POM-dendrimer self-assembly and photocatalysis in aqueous solution as investigated in this study. Catalyzed model reaction is the photo-degradation of the dye methyl red.

Structures and data on gold and CdS hybrid structures turned out to be more complex than expected and the projects on these structures are still ongoing.

Publications:

1. A. Kutz, G. Mariani, R. Schweins, C. Streb, **F. GRÖHN**, "Self-Assembled Polyoxometalate-Dendrimer Structures for Photocatalysis", *Nanoscale*, **2018**, *10*, 914.

2. Anne Kutz; Self-Assembled Structures for Functional Nanoparticles, Dissertation Friedrich-Alexander Universität Erlangen-Nürnberg, Januar **2017**.

3. Giacomo Mariani, Scattering analysis of supramolecular nanoparticle formation through electrostatic self-assembly, Dissertation Friedrich-Alexander Universität Erlangen-Nürnberg, Juli **2017** (summa cum laude).