Contribution ID: **43** Type: **Poster**

Self-assembly of dendrimers and oppositely charged dyes as a function of solvent pH and salt content

Self-Assembly is a widely occurring phenomenon in nature. Understanding the shape-determining factors is key for tailoring nanoparticles with desired structural properties. Furthermore, switchability between disassembled and the assembled state through external triggers would increase the application potential. This contribution will discuss nanoparticles consisting of positively charged polyelectrolytes and oppositely charged multivalent organic dye molecules. The main focus will be put on Polyamidoamine (PAMAM) dendrimers as polyelectrolyte. Depending on the dendrimer generation and the valency of the employed dye molecule a vast variety of either elongated shapes or spherical shapes, both also as core-shell particles, can be generated. pH triggers the assembly process as at high pH the PAMAM is neutral and thus not forming complexes with the dye molecules. The nanoparticles were characterized using static and dynamic light scattering (SLS & DLS) as well as small-angle neutron scattering (SANS). The results were complemented by UV-Vis spectroscopy and isothermal titration calorimetry (ITC). Gathering all the information from structural characterization and thermodynamics allows to elucidate the self-assembly process and consequently to predict the shape of nanoparticles formed. A general combination of interactions like electrostatics, counterion release and geometric constraints governs the self-assembly process rather than one specific binding motif. UV light may also serve as a trigger to change the size and shape of self-assembled nanoparticles, as illustrated by an example using a linear cationic polyelectrolyte together with an isomerizable dye molecule.

Preferred topic

Gels and nanoparticles

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