Synthesis and study of the aggregation behavior of block-copolymers

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Block-copolymers can show a large variety of properties due to their architecture parameters such as block length and solubility of the blocks, thereby rendering such copolymers very flexible amphiphilic molecules. Having this in mind it is interesting to think of having molecular parts sensitive to external stimuli such as temperature or pH. The interaction between the polymers or different types of polymers can be affected by changing experimental parameters.

We synthesized our polymers by using the Atom Transfer Radical Polymerization (ATRP) technique. The basic idea was to start from a Polyethyleneoxide (PEO) block and add side chains of poly acrylic acid (PAA) or 2-(dimethylamino)ethyl methacrylaste (DMAEMA) as potentially anionic or cationic block (depending on pH). These then are doubly hydrophilic cationic or anionic diblock copolymers. In addition, we also produced polymers containing statistical mixtures of acrylic acid with n-butyl or n-lauryl acrylate. With these one introduces hydrophobic properties into the copolymers. The reaction progress, the composition and the purity of the product was followed by 1H-NMR, the molecular weight by GPC. Titration shows the amount of accessible functional groups according to the calculated ones we got out of the 1-H NMR data.

As a first step the self-aggregation behavior for the polymers containing different hydrophobic side chains was investigated as a function of pH by means of scattering methods (SLS, DLS, SANS) and isothermal titration calorimetry (ITC). Systematic changes as a function of the relative content of hydrophobic side chains and the length of the alkyl chain were observed. Furthermore we also studied complexes of oppositely charged copolymers, where zeta potential measurements yield additional interesting informations. Such complexes are very interesting of building complex colloidal systems that have interesting potential for future applications, for instance as delivery systems.