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Alternating sequence-controlled polymers with thermo-, pH- and selective ion-induced phase transition

Stimuli-responsive polymers are capable of modifying their chemical/physical properties upon exposure to different stimuli (temperature, pH, ionic strength). On another hand the currently emerging development of sequence-controlled copolymerization strategies open up opportunities for the design of new generations of smart polymers [1]. Methods like iterative single addition of monomers by living polymerization effectively give access to sequence-controlled polymers but with low yield / efficiency ratios. Alternate approaches through cyclo- and template-polymerization [2] of cleavable multi-vinyl monomers are potentially suitable to synthesize larger quantities of sequence polymers making it possible to envision practical applications in the field of materials. A new alternating sequence-controlled copolymer has been synthesized by cyclopolymerization of divinyl monomers with hemiacetal ester cleavable pendant groups. After cleavage of these groups, an alternating sequence (AS) of carboxylic acid and hydroxide groups was obtained [3]. Here, we present the synthesis of this AS-copolymer and we investigate the influence of the temperature, the pH and ions on the polymer solution behavior, using a laser scattering and diode detection system. In an organic solvent (1,2-dimethoxyethane), the alternating sequence of two functional groups provided a lower critical solution temperature (LCST) around 22℃. In water, the LCST is only observed at low pH conditions (pH<3, LCST from 25 to 38℃). Moreover, this copolymer shows a selective ion-induced LCST-transition in response to K+ and Ag+ cations; while in the presence of Na+, Cu2+ and Li+ no phase transition was observed. Molecular dynamic (MD), SANS and IR spectroscopy studies have been completed to elucidate the LCST behavior. This alternating sequence copolymer is a promising new candidate for sensors and membranes for selective cation recognition.

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Preferred topic

Conformation of polymers in solvents

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