Functional Compartmentalized Anisotropic Colloidal Gels

Andrij Pich

DWI Leibniz Institute for Interactive Materials, RWTH Aachen University

pich@dwi.rwth-aachen.de

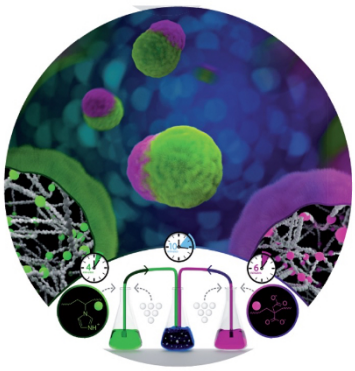
Soft colloidal structures with programmable chemical functionalities, size and shape are important building blocks for the fabrication of catalyst systems and adaptive biomaterials for tissue engineering. However, the development of the easy up-scalable and template-free synthesis methods to obtain such colloids lack of understanding of molecular interactions that occur during the synthesis step.

We demonstrate that the use of "programmable" monomers able to undergo specific non-covalent interactions (electrostatic, hydrophobic or π-π-stacking) in aqueous solutions is a key to bottom-up synthesis of anisotropic nanogels with controlled size, shape and chemical structure. A new synthesis method based on the controlled self-assembly of growing polyelectrolyte microgel precursors during the precipitation polymerization process leading to the formation of polyampholyte Janus-like microgels was developed. [1] In another approach, we used pyrazole-modified monomers able to undergo π-π-stacking and guide the formation of supramolecular bonds between polymer segments and used them in precipitation polymerization to synthesize anisotropic microgels. [2] Anisotropic nanogels were synthesized through semi-batch precipitation polymerization using 4-methoxybenzoic acid 4-(6-acryloyloxy-hexyloxy)phenyl ester (LCM) as a functional co-monomer with a liquid crystalline moiety. The resulting morphology of nanogels is tuned to multilobe-, dumbbell-, and raspberry-like shapes by varying the addition time of LCM, temperature, solvent ratio, and monomer ratio.

Using controlled liquid-liquid phase separation in microfluidic droplets, we developed a new methodology to fabricate compartmentalized anisotropic microgels. [4] Phase separation of nanogels in aqueous microfluidic droplets triggered by addition of salt, allows fabrication of stimuli-responsive anisotropic compartmentalized microgels with tunable sizes and internal morphologies. [5]

The application of anisotropic compartmentalized nanogels and microgels in catalysis [6] , drug delivery [7] and soft robotics will be discussed.

Keywords:
nanogels, microgels, compartmentalisation, anisotropic colloids



Anisotropic nanogels synthesized by polymerisation and coacervation-driven assembly of functional monomers.

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