YOUNG MACROMOLECULAR RESEARCHER WEBINAR

Tue 26-March 2024 15:00-15:45 (UK)

Julian Heuer, Max Planck Institute for Polymer Research

Tunable Photocatalytic Selectivity by Altering the Active Center Microenvironment of an Organic Polymer Photocatalyst

We present the production of photocatalytic self-assembled amphiphilic polymers using PISA-RAFT techniques, with either hydrophilic or hydrophobic microenvironments at the reactive centre. Controlling the microenvironment of the photocatalytic centre allows for careful investigation regarding solvation effects, reactivity influences by the polymer microenvironment and possible assembly promoted reactivity processes. Stark differences in reactivity were observed for polar substrates, where a hydrophilic microenvironment was favoured. Conversely, both microenvironments performed similarly for very hydrophobic substrates, showing that reagent partitioning is not the only factor that drives photocatalytic conversion, pointing towards possible diffusion limited processes. Moreover, by further alteration of the catalytic species with a secondary swelling solvent, the performance was further modified and could be optimized with a maximal 5.4-fold increase in conversion rate.

Dr. Andrea Belluati, Technical University of Darmstadt

Life, synthetic: biocatalytic polymerisation-induced self-assembly for artificial cells

Artificial cells, serving as biomimetic microstructures, emulate the functionalities of natural cells, becoming building blocks in molecular systems engineering and serving as vessels for synthetic biology. We unveil the creation of polymer-based artificial cells, synthesized enzymatically, with a capability for protein expression. The construction of artificial cells was accomplished utilizing biocatalytic atom transfer radical polymerization-induced self-assembly (bioPISA). To this end, myoglobin facilitates the synthesis of amphiphilic block copolymers, which self-organize into various structures including micelles, worm-like micelles, and giant unilamellar vesicles (GUVs). Throughout the polymerization process, the GUVs encapsulate diverse cargo, encompassing enzymes, nanoparticles, microparticles, plasmids, and even cell lysate. Consequently, the formulated artificial cells function as microreactors, facilitating enzymatic reactions and osteoblast-inspired biomineralization. Furthermore, upon being supplied with amino acids, they are able to express proteins, including a fluorescent protein and actin. Actin polymerizes within the vesicles, modifying the internal structure of the artificial cells by forming a cytoskeleton mimic. Therefore, GUVs produced via bioPISA can emulate bacteria, constituting a microscopic reaction compartment that holds genetic information, enabling protein expression upon induction. Moreover, artificial cells can be further equipped with internal compartments in sequential reactions, imitating the eukaryotic cell subdivisions.