Technische Universiteit Eindhoven University of Technology

Water-Soluble Supramolecular Polymers

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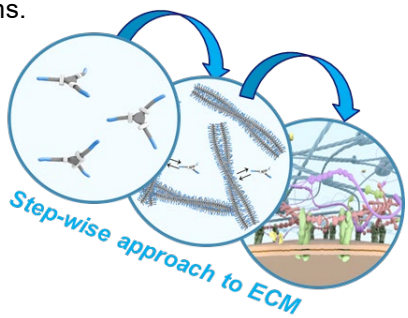
Supramolecular Polymers in Water

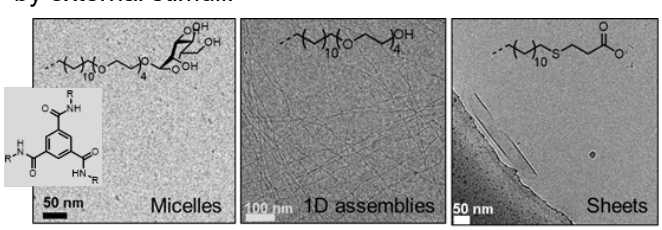
Supramolecular polymers provide a conceptually novel approach for mimicking many aspects of the extracellular matrix (ECM). To synthetically recreate the complexity of the ECM, we select a bottom-up approach in which we study several synthetic systems with a special focus on benzene-1,3,5-tricarboxamide-based supramolecular polymers. By understanding the relation between molecular structure, stability, and dynamic behavior in water, we go step-by-step from small molecules to supramolecular polymers to highly functional biomaterials that mimic the functions of the ECM. In this step-wise approach, we encounter many challenges that are open to study in order to arrive at life-like systems.



Fundamentals of assembly of BTAs in H_2O

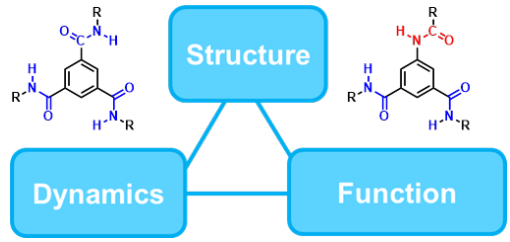
We recently started to elucidate how the morphologies formed by BTAs in water depend on the size and nature (neutral, charged) of the water-soluble part. As a result, spherical micelles, cylindrical micelles and sheet-like structures can be accessed by small changes in the molecular structure. Moreover, we studied the dynamics of the assembly-disassembly process using mass-spectrometry.

After studying the homopolymers, we have studied copolymers in order to control the structure, dynamics and functionality. In a next step we like to fully understand on how the assembly process is governed by external stimuli.



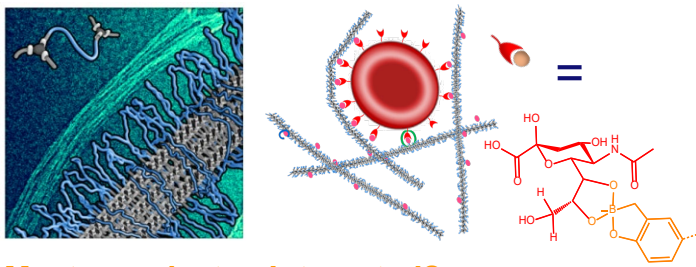
The Magic Triad

We systematically probe the relation between molecular structure, stability and dynamic behavior of supramolecular polymers of a series of BTA-based molecules. Hereby, we recently elucidated that BTAs tend to form double helices in water, which enhances their stability. More importantly the copolymerization of different types of monomers allows to tune stability and dynamic behavior independently. These copolymerizations need further optimization and quantification with focus on functionality.



Hydrogels and Multivalent Structures

Telechelic BTA-end-capped polymers can form elastic hydrogels in water, which can be tuned by competitive interactions. Also using differently functionalised BTAs, the dynamics are tuned at both the nanoscopic and macroscopic level. In this way, we could obtain multivalent interactions between functional supramolecular polymers and cell surfaces. Finally, we can introduce bioactivity into the hydrogels; a first step to arrive at artificial ECM materials; however, many challenges are still to be solved.



Master projects - Interested?

Our team is looking for passionate master students (ST or BMT) interested in working at the interface of chemistry and biology. Interest in synthesis, detailed analyses of supramolecular structures and biological challenges are desired to be successful.

/ Macromolecular and Organic Chemistry

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