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Observing the structure of non-fouling polymer brushes in aqueous solutions

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Hydrophilic polymer brushes are widely utilized in biomedical applications to prevent non-specific interactions with biological fluids. While the chemical structure of the coating plays an important role in the non-fouling character and bio-functionality, the physical state of polymer chains determines the coating's properties. However, the actual physical state of the polymer chains constituting the coatings has been rarely accessed. The understanding of physical state, interfacial behavior and the investigation of conformation changes of the polymer brushes when exposed to various aqueous solutions and external stimuli is important for the correct design of biomaterials. The conformation of grafted polymer chains at the solid-liquid interface can strongly depend on the polymer brush grafting density but also on the type and concentration of salts in the surrounding aqueous phase.

In this contribution, we will report on our efforts to thoroughly examine the chemical and physical structure of polymer brushes synthesized via surface-initiated atom transfer radical polymerization (SI-ATRP) from initiating moieties bound on the surface. By tuning the surface concentration of initiating groups, we have synthesized polymer brushes of various grafting density. We have employed various surface sensitive techniques to thoroughly examine the chemical and physical structure of the polymer chains. Furthermore, we have probed the viscoelastic response of the brushes of various grafting densities by combining ex- and in-situ acoustic QCMD and variable angle spectroscopic ellipsometry (VASE) measurements. The concomitant QCM-D-VASE analysis provided insights of the scaling behavior of the end-tethered polymer brushes and their conformational behavior not only when contacted with water but also when exposed to anions of the Hofmeister series.

Hauptautoren: ROMANENKO, Iryna (Czech Academy of Sciences); SIVKOVA, Radoslava (Czech Academy of Sciences); SVOBODA, Jan (Czech Academy of Sciences); RIEDEL, Tomaš (Czech Academy of Sciences); DE LOS SANTOS PEREIRA, Andres (Czech Academy of Sciences); POP-GEORGIEVSKI, Ognen (Czech Academy of Sciences)

Vortragende(r): POP-GEORGIEVSKI, Ognen (Czech Academy of Sciences)

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