Beitrag ID: **39** Typ: **Talk**

Stimulus Responsive Polymer Brushes for Control of Static and Dynamic Wetting with Lipid Vesicles

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We designed and fabricate stimulus responsive polymer brushes which can switch the chain conformation reversibly in response to addition/removal of small amount of Cd2+ions. Design of the polymer structure was inspired by plant protein (phytochelatin) that selectively detect and capture Cd2+ ions. As our polymer realized an excellent affinity to Cd2+ (KD ~ 10-9 M), the brush conformation and mechanical properties can be switched without changing the osmolarity of electrolytes.[1,2]
The surface coated by this bio-inspired polymer brush was used to switch the wetting with lipid vesicles, whose shape are determined not only by tension but also by elasticity. First we observed the shape of vesicles at various [Cd2+] and found that cell-sized giant vesicles (diameter ~ 10 μm) adapt their shape in response to [Cd2+], yielding the critical concentration causing wetting/non-wetting transition. Within SPP2171, we collaborated with Müller Group (Göttingen) and demonstrated that our experimental data were quantitatively reproduced by simulations.3 Moreover, we successfully observed the dynamic wetting transition in real time by integrating the brush system into microfluidics.[3] Owing the outstanding affinity and selectivity to Cd2+, this material has recently been used for the treatment of polluted groundwater, which is considered as a "synthetic phytoremediation".[4]

1. Yamamoto, A., Hayashi, K., Sumiya, A., Weissenfeld, F., Hinatsu, S., Abuillan, W., Nakahata, M., and Tanaka, M. (2022). Modulation of viscoelasticity and interfacial potential of polyelectrolyte brush by Ion-specific interactions. Frontiers in Soft Matter 2, 959542. 10.3389/frsfm.2022.959542.
2. Yamamoto, A., Ikarashi, T., Fukuma, T., Suzuki, R., Nakahata, M., Miyata, K., and Tanaka, M. (2022). Ion-specific nanoscale compaction of cysteine-modified poly(acrylic acid) brushes revealed by 3D scanning force microscopy with frequency modulation detection. Nanoscale Advances 4, 5027-5036. 10.1039/D2NA00350C.
3. Weissenfeld, F., Wesenberg, L., Nakahata, M., Müller, M., and Tanaka, M. (2023). Modulation of wetting of stimulus responsive polymer brushes by lipid vesicles: experiments and simulations. Soft Matter 19, 2491-2504. 10.1039/D2SM01673G.
4. Nakahata, M., Sumiya, A., Ikemoto, Y., Nakamura, T., Dudin, A., Schwieger, J., Yamamoto, A., Sakai, S., Kaufmann, S., and Tanaka, M. (2024). Hyperconfined bio-inspired Polymers in Integrative Flow-Through Systems for Highly Selective Removal of Heavy Metal Ions. Nature Communications 15, 5824.

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Sitzung Einordnung: Short Talks