Study of temperature switchable adhesion between ligands and receptors by Soft Colloidal Probes

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Adhesion in aqueous media is crucial for many processes in nature. Moreover, controlling adhesion in aqueous media is very important for technology, e.g. in cleaning processes or adhesive development [1]. Those interactions can be measured indirectly with methods like quartz crystal microbalance (QCM) or directly with atomic force microscopy (AFM). However, AFM is rather expensive and slow and methods like QCM merely detect the amount of adhered material but not the involved adhesion energy. Therefore, a new fast and straightforward method has been developed to measure adhesive interactions. The method utilizes soft hydrogel particles as sensors (soft colloidal probes, SCPs) which allows to determine adhesion energies by optical microscopy and evaluation with JKR model [2].
Using the SCP method adhesion energies can be measured, e.g. interactions between polymers or ligands and receptors [3]. Based on this, the temperature responsive adhesion of LCST polymers can be directly characterized with functionalized SCPs (figure 1). Additionally, functionalizing thermoresponsive polymers with ligands, e.g. carbohydrates, allows systematic investigation of switchable adhesion to receptor-functionalized surfaces, e.g. lectin functionalized glass slides. We hope that this will reveal the optimal material properties of the thermoresponsive polymer networks, e.g. swelling degree or ligand presentation, for maximized stimulus-control over specific interactions

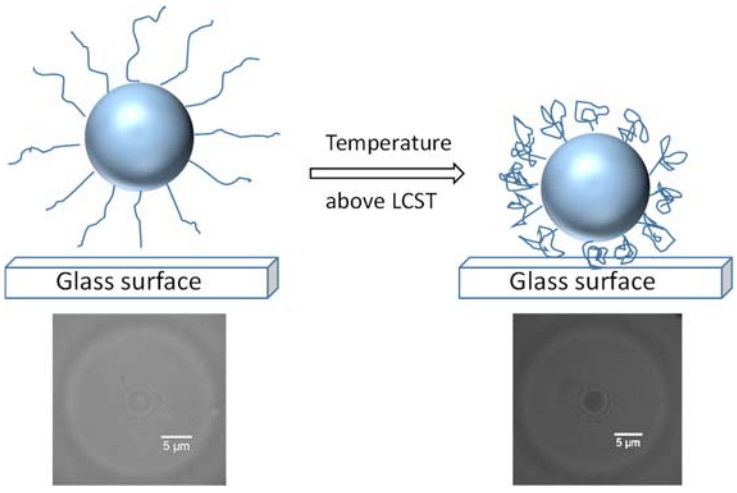

Figure 1. Behaviour of thermoresponsive polymers on colloidal probe surface and switchable adhesion to glass surface (left) below lower critical solution temperature (LCST) and (right) above LCST. The microscope images show the increase of the contact area from below (white spot) and above (dark spot) between colloidal probe and glass surface.

[1] H. G. Silverman, F. F. Roberto, *Mar. Biotechnol.* **2007,** *9* (6), 661-681.
[2] D. Pussak et al., *Soft Matter* **2012**, 8, 1664-1672.
[3] A. Strzelczyk et al., *Gels* **2017**, *3*(3), 31

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