Polymer physisorption at cellulose surface from non-polar medium

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Physisorption of hydrophobic polymers from non-polar solvent medium is an underutilized tool for modification of surfaces, especially of soft matter. In the case of the inherently hygroscopic cellulose, the well-established routes for surface modification via polymer physisorption have traditionally been limited to adsorption of polysaccharides or cationic polyelectrolytes from aqueous solutions. The potential of utilizing non-polar solvent medium for modification of cellulose surface was demonstrated in our earlier work [1] where the wettability of cellulose nanopapers was successfully tuned using physisorption of hydrophobic polymers. In the current study [2], physisorption phenomenon from non-polar medium on cellulose is studied in more detail utilizing quartz crystal microbalance with dissipation monitoring (QCM-D). The effect of the molecular size of the adsorbate polymer are investigated at theta condition. Comparison of cellulose surface to another hydrophilic adsorbent, silica, is also presented. Despite some conformational differences upon the polymer layer formation process depending on the adsorbent, adsorption of hydrophobic polymer from non-polar environments was shown to be mainly irreversible and to result in effective hydrophobisation on both studied surfaces. The non-aqueous treatment is truly surface-specific, preserving the structural integrity of the interfibrillar cellulose network. The approach opens up an arsenal of alternatives to covalent surface modifications.

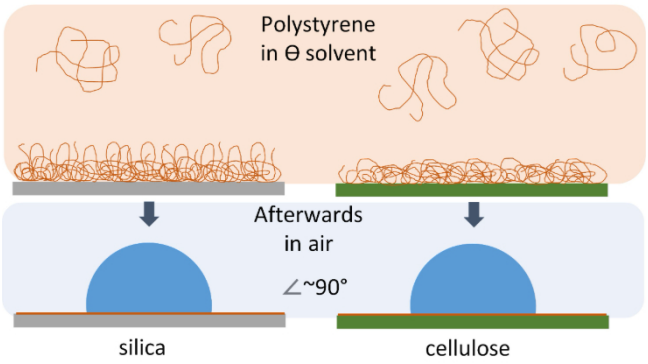

Figure 1. Polystyrene physisorption onto silica and cellulose from a non-polar θ-solvent, and the resulting hydrophobisation in air.

References:

[1] Kontturi, K.S. Biegaj. Mautner. Woodward. Wilson. Johansson. Lee. Heng. Bismarck. Kontturi, E. Noncovalent surface modification of cellulose nanopapers by adsorption of polymers from aprotic solvents, *Langmuir* **2017** , *33* , 5707-5712.
[2] Kontturi, K.S. Solhi. Kontturi, E. Tammelin. Adsorption of polystyrene from theta condition on cellulose and silica studied by quartz crystal microbalance, *Langmuir* **2024** , *40* , 568-579.