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Modification of cellulosic surfaces

Cellulose is ubiquitous and almost inexhaustible polymeric raw material which possesses unique structure and properties. Recently, there has been an increase in attention towards cellulose, cellulose derivates and other polysaccharides due to a growing need for renewable, sustainable and environmentally compatible materials and processes. Films prepared from nanocellulosic materials are shown to have good mechanical and oxygen barrier properties, low coefficient of thermal expansion and furthermore they can be transparent and flexible. Chemical modification of cellulose is challenging. Strong stability in nature, highly ordered supramolecular structures and the consequent immiscibility in common solvents are the reasons why chemical reactions often proceed in a counter-intuitive fashion with respect to familiar pathways in organic chemistry. Conventional chemical methods to modify cellulose include esterification, etherification and oxidation of the hydroxyl groups. Many of the methods are not directly applicable to nanocellulosic entities and they have to be adjusted for each cellulose substrate. Other means to modify cellulose surfaces include polysaccharide adsorption, click chemistry, enzymatic treatments and polyelectrolyte multilayers and complexes. The aim of my thesis is to study the behaviour of nanocellulosic materials during and after chemical modification and to design novel strategies to modify cellulose, applicable in nanoscale (Figure 1).

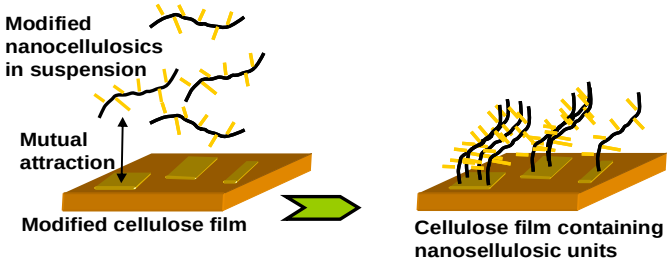

Figure 1 Schematic drawing of the possible process to modify ultrathin cellulose films with nanocellulosic units.

Recently, it was demonstrated how cellulose films with nanosized polystyrene (PS) domains can be obtained by blending PS with trimethylsilyl cellulose (TMSC), spin coating and subsequent hydrolysis of TMSC to cellulose. When PS is applied as the minority phase, tuning the PS concentration results in a series of cellulose films with PS domains of controllable sizes. Since one component is hydrophilic (cellulose) and the other hydrophobic (PS), finely tunable hydrophobic properties are intrinsically linked to the preparation of these films. In other words, a method to quantitatively modify the surface chemistry of ultrathin cellulose films in a single step during the film preparation was presented (Figure 2). (Nyfors *et al*. *Biomacromolecules* 2009).

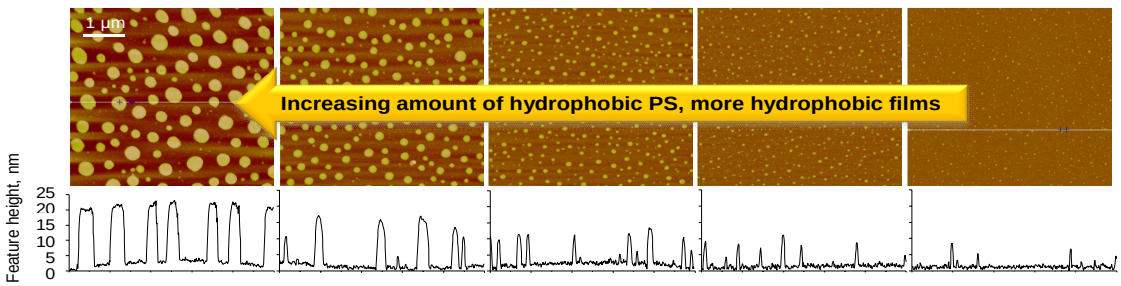

Figure 2. Tailored PS/Cellulose ultrathin films.