

**THE UNIVERSITY OF MELBOURNE  
DEPARTMENT OF CHEMICAL & BIOMOLECULAR ENGINEERING  
DEPARTMENTAL SEMINAR 2008**

**SPEAKER:**           **Professor Manfred Stamm**  
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Dresden, Germany*

**TOPIC:**               **Surfaces with Functionality:  
Switchable and Adaptive Polymer Brushes**

**DATE:**               **Thursday, 20th November, 2008 @ 12 noon**

**PLACE:**              **Chemical & Biomolecular Engineering Theatre**  
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### **ABSTRACT**

Adaptive properties can be achieved with functional brush surfaces at nanometer scale which are of interest for several possible applications. A fairly robust way for the generation of a functional thin film is the attachment of polymer chains to the surface by covalent bonding. At high grafting density a brush-like layer will be formed, and surface properties can be changed significantly. Utilizing mixed polymer brushes the surface properties can be switched between different states, and it is even possible to switch between ultra-hydrophobic and ultra-hydrophilic behavior by introduction of additional surface roughness, i.e. a combination of physical and chemical modification of the surface. Depending on solvent conditions, one or the other polymer chain occupies the surface layer and thus determines surface properties, which depend on the outermost surface layer. With selective solvents a wide range of surface properties can be achieved. The thin polymer brush films are laterally structured in the dry state, which can be investigated by AFM. The surface properties can in addition be modified by the introduction of nanoparticles, which may be attached to the polymer brush chains. Depending on the degree of swelling of the brush layer, the nanoparticles will be close to the surface or further away. If the nanoparticles emit fluorescence light, the different emitted beams will interfere with each other in different ways depending on the distance to the surface. Thus the emitted light intensity will be modulated and can reveal information on the state of swelling, in this way serving as a sensitive optical sensor for the degree of swelling of the brush. The adsorption of polyelectrolytes and protein molecules is similarly depending on the state of the brush. In particular salt concentration and pH will influence the adsorbed amount. In a fluid cell of an ellipsometric set-up the adsorption can be measured in-situ and as a function of time. We were able to identify a regime where the adsorbing molecules repel the attached counterions in the brush (counterion evaporation effect) and where the adsorption process is favored by the entropic driving force. Investigations of this sort are very much easier, when gradient brush layers are utilized. There the composition of the brush or the grafting density is varied uniformly along the silicon wafer. In one adsorption experiment several parameters then can be investigated in a time efficient way.

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