Puu-19.4020 Surface Chemistry and Nanotechnology in Forest Products Technology
Exam 09.03.2009

1) a) Describe shortly the concept of self-organization.
b) Surfactants are formed by wood extractives in the cook. Explain briefly by which mechanism they associate in solution as well as adsorb on solid surfaces. Give examples of practical importance of these phenomena.

2) What kind of surface properties is needed to obtain a superhydrophobic surface? In which way superhydrophobicity can be utilized to make so called self-cleaning surfaces?

3) What are the main differences between nanofibrillar cellulose and nanocrystalline cellulose? How are they produced?

4) Describe briefly the basics of measuring adsorption using a) the quartz crystal microbalance with dissipation (QCM-D) and b) ellipsometry What are the most obvious differences between these two methods and how does that affect the obtained results?

5) The separation D between two static spherical particles is 20 nm. At this point, polymer bridging is causing a force of 0.01 nN at the salt concentration, c, of 10 mM. Both surfaces having the radius (a) of 1 µm are equally and positively charged. What should the surface potential Φ be so that the total force F is attractive? We assume that no other forces are present than electrostatic double-layer (DL) force and polymer bridging. One or more of the following equations are needed to solve the surface potential.

$$\kappa^{-1}(nm) = 0.304\sqrt{\left(\frac{c_0}{mol/dm^{-3}}\right)}^{-1}$$

Debye-Hückel equation: $\Phi(D) = \Phi_0 \exp(-\kappa D)$

$$F_{DL} \approx 2\pi\varepsilon_0\varepsilon_r a\kappa\Phi^2 \exp(-\kappa D)$$

$$F_{hydrodynamic} = 6\eta v a^2 D^{-1}$$

ε_r = 78.5, ε_0= 8.854*10^{-12} J^{-1}C^{2}m^{-1}, η = 8.90*10^{-4} Pa s