Polyelectrolytes on Surfaces

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INTRODUCTION: Adsorption of charged macromolecules, polyelectrolytes, on oppositely charged surfaces is important for many technical applications including surface and material modification as well as separation of biomolecules. Furthermore, life processes are affected by such electrostatic interactions.

For the adsorption of highly charged cationic polyelectrolytes on oppositely charged porous materials and on oppositely charged Langmuir monolayers the influence of molecular and electrostatic characteristics has been studied. These included the molecule size, the chemical structure and the ionic strength of the medium.

METHODS: Poly(vinylbenzylammonium chloride) (PVBAC) samples were synthesized and characterized as described previously [1, 2].

Porous surfaces: Adsorption isotherms have been monitored using strong acidic cation-exchange microspheres of PS-DVB. Two techniques were applied, which yielded the adsorbed amount: adsorption on materials packed in chromatography columns [2] and adsorption on microspheres suspended in aqueous medium.

Langmuir monolayers: The model polyelectrolytes were adsorbed on monolayers of dimyristoylphosphatidic acid. [3].

RESULTS: As an example, Fig. 1 illustrates experimental results on porous surfaces, the tendencies of the adsorption behavior influenced by the ionic strength.

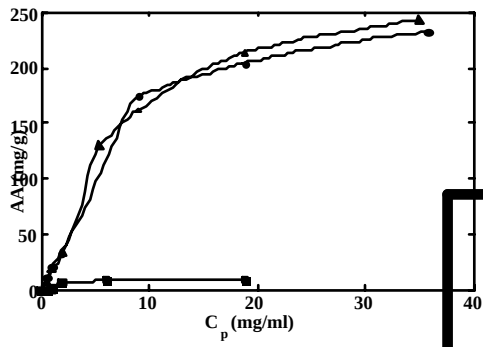

Fig. 1. *Adsorbed amount, AA, vs. initial polyelectrolyte concentration, C_p, in: (ν) water, (σ) 0.075 M NaCl, (λ) 0.225 M NaCl. T=25°C.*

DISCUSSION & CONCLUSIONS:

Adsorption on porous surfaces: Electrostatic exclusion, in addition to size exclusion, was quantitatively proved evaluating molecular, electrostatic and geometrical parameters (Fig.2).

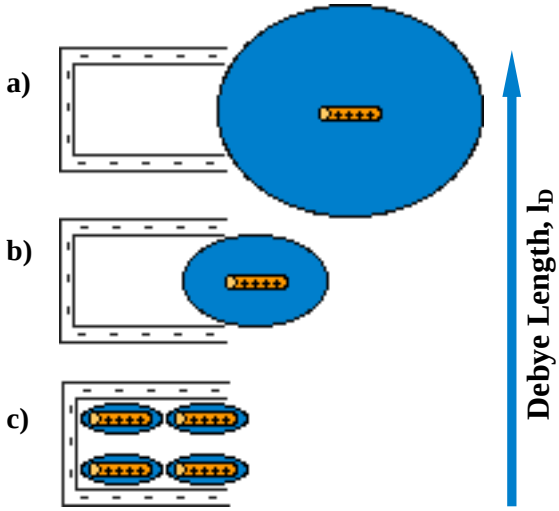

Fig. 2. *Model proposed to illustrate the adsorption of molecules with L=6 nm on microsphere with d_p=10-14 nm in water:* ***a)*** *C_p=0.5 mg/ml, l_D=14.6 nm;* ***b)*** *C_p=6 mg/ml, l_D=4.2 nm, and in 0.075M NaCl:* ***c)*** *C_p=2 mg/ml, l_D=1.1 nm. (L=contour length, d_p=pore diameter, l_D=Debye length)*

Adsorption on monolayers: Pressure-area and pressure-time isotherms revealed an increase of both the area per amphiphile molecule and the surface pressure as a function of time if the polyelectrolyte adsorbs on the amphiphile. Size dependent incorporation of the hydrophobic substituents into the monolayer and end group effects are suggested as the reason for differing monolayer extension.

REFERENCES: [1] W.Jaeger, U.Wendler, A.Lieske, J.Bohrisch, C.Wandrey (2000) *Macromol. Symp.* **161**, p.87-96 [2] V.Malinova, R.Freitag, C.Wandrey (2004) *J. Chromatogr. A* **1036**, p.25-32 [3] V.Malinova, H.Menzel, C.Wandrey (2004) *Progress of Colloid and Polymer Sci.* **129**, p.1-8

ACKNOWLEDGEMENTS: The Swiss National Science Foundation is gratefully acknowledged for the financial support, grants: 2100-611314 and 2000 20-101652.