Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Strong and weak adsorptions of polyelectrolyte chains onto oppositely charged spheres ANDREY CHERSTVY, Max Planck Institute for the Physics of Complex Systems, ROLAND WINKLER, Institut für Festkörperforschung, MPIPKS-FZJ COLLABORATION — We investigate the complexation of long thin polyelectrolyte chains with the oppositely charged sphere. In the limit of strong adsorption, when strongly charged polyelectrolyte chains adapt definite wrapped conformations on the sphere surface (solenoidal, tennis-ball-like, etc.), we analytically solve the linear Poisson-Boltzmann equation and calculate the electrostatic potential and energy of the complex. We discuss some biological applications of the obtained results, including those for DNA wrapping in the nucleosome core particles and for aggregate formation of DNA with oppositely charged nano-spheres studied in vitro. For weak adsorption, when a flexible weakly charged polyelectrolyte chain is localized next to the sphere in solution, we solve the Edwards equation for the chain conformations in the Hulthén potential. The latter is used as an approximation for the screened Debye-Hückel potential of the sphere. For arbitrary sphere radius, we predict the critical conditions for polyelectrolyte adsorption as a coupling between critical sphere and polyelectrolyte charge densities, sphere radius, temperature, and ionic strength in solution. We find that the critical charge density of the sphere exhibits a distinctively different dependence on the Debye screening length than for polyelectrolyte adsorption onto a flat surface. We compare our findings with experimental measurements on complex formation of various polyelectrolytes (DNA, PSS, AMPS, etc.) with oppositely charged colloidal particles and cationic micelles, where similar universal scaling relations for the sphere charge density have been revealed.

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Date submitted: 27 Dec 2006 Electronic form version 1.4