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Title
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Permalink
https://escholarship.org/uc/item/8dq9h89n

Journal
BIOPHYSICAL JOURNAL, 88(1)

ISSN
0006-3495

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Publication Date
2005

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Claus Czeslik, Theodore L Hazlett, Enrico Gratton, Roland Steitz, Hans-Hennig von Grünberg, and Matthias Ballauff.

Effect of salt on the immobilization of proteins at polyelectrolyte brushes.

49th Annual Meeting of the Biophysical Society, Long Beach, California, 2005.
Biophys J. 2005; Suppl, 1893-Pos/B5.

Abstract

We used two-photon excitation fluorescence fluctuation spectroscopy and neutron reflectometry to study the effect of salt concentration on the degree of protein binding to spherical and planar polyelectrolyte brushes. The binding of bovine serum albumin (BSA) to poly(acrylic acid) (PAA) brushes was characterized at neutral pH-values where both the protein and the brushes carry a negative charge. It has been found that BSA binds strongly to these brushes under electrostatic repulsion at low ionic strength. The BSA volume fraction profile, as determined from the neutron reflectivities, indicates a deep penetration of the BSA molecules into a planar PAA brush. However, when the ionic strength of the protein solution is raised to a few 100 mM, the BSA binding capacity of spherical and planar PAA brushes decreases drastically. A simple mean field approach is given that explains these experimental findings. The model predicts a large gain of free energy associated with the release of BSA counterions on transferring a BSA molecule from the solution into a PAA brush. The free energy change of this counterion evaporation is entropic in nature and dominates over the electrostatic repulsion between the BSA molecules and the like-charged PAA brush. In a general view, the switching of the protein affinity of a PAA brush by varying the ionic strength of the protein solution over a small range may appear to be useful for biotechnological applications.