Supporting Information – Spermidine-induced attraction of like-charged surfaces is correlated with the pH-dependent spermidine charge: force spectroscopy characterization

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Surface charge of the borosilicate beads

Particle electrophoresis was employed to determine the zeta potential and surface charge density of the beads. A detailed description of the setup (modified Parmoquant 2-microscope, Carl-Zeiss, Jena, Germany) has been given by Gimsa and Gimsa.[1] In short: 1 g of bead powder was suspended in 50 ml of aqueous solution. The electrophoretic mobility of the beads was microscopically determined in the frontal stationary plane of the electrophoretic measuring chamber at 21.1% of the chamber depth.[2] The field strength was adjusted to 2 kVm^{-1} with a constant current source (Metz/Carl Zeiss, Fürth, Germany) taking the chamber constant and the conductivities of the measuring solutions into account. The conductivities were measured with a conductometer (inoLab, WTW, Weilheim, Germany).

The bead velocities were determined by measuring the travelling time for distances of 80 µm. For each bead, a second value was measured after reversal of the field direction. At each pH, at least 50 borosilicate beads were measured. Finally, the surface charge densities were calculated from the averaged electrophoretic mobilities using the viscosity of the measuring solutions, which were determined with a ball draw viscosimeter (VEB MLW, Prüfgeräte-Werk, Medingen, Germany).

The obtained charge densities were between -0.0115 and -0.0294 As/cm^2 (Figure S1). ANOVA testing showed that the detected surface charge densities were pH-independent ($p<0.05$). For the measuring conditions used in the force experiments, we estimated surface potentials in the range from -80 to -100 mV.

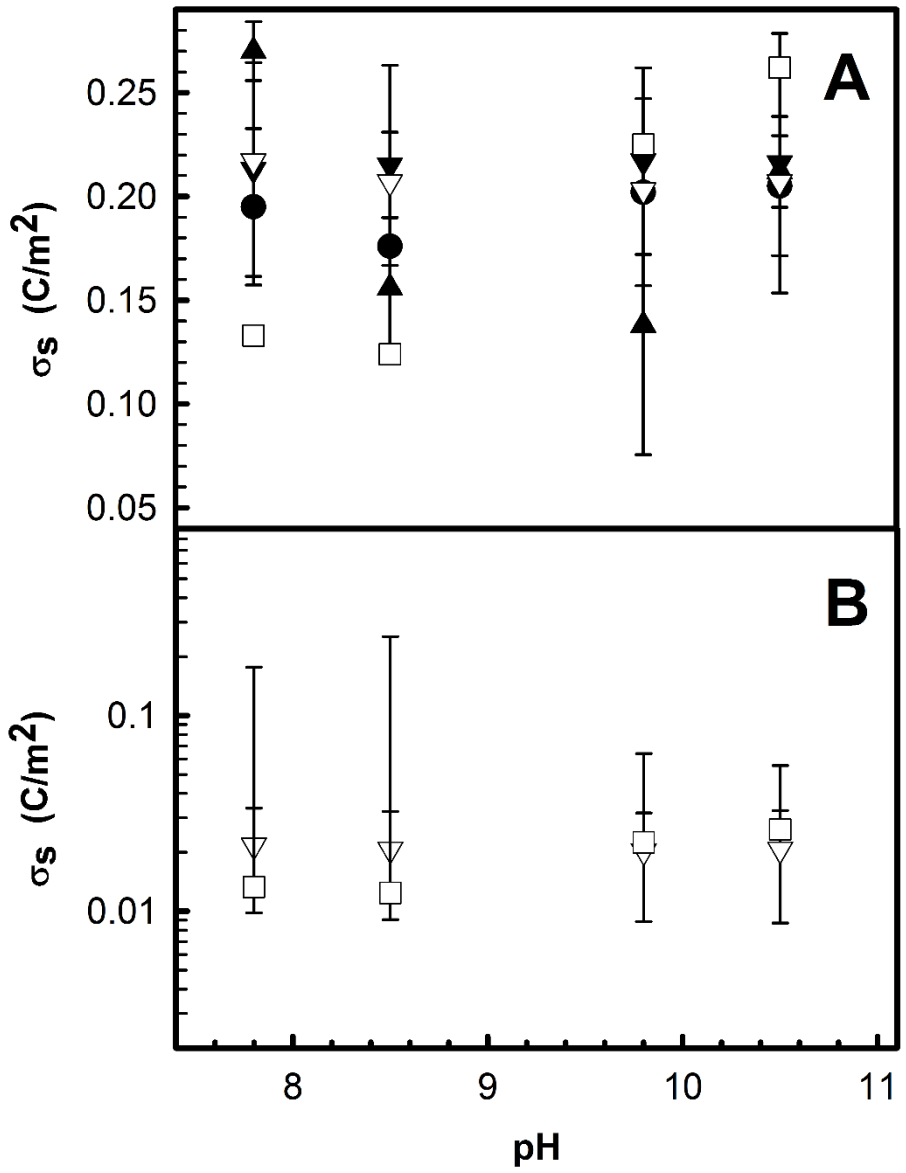

Figure S1. pH-dependence of the surface charge density [means ± standard deviations] of borosilicate beads at an ionic strength of 30 mM (filled triangle), 50 mM (filled circle), 70 mM (filled triangle down), 100 mM (white triangle down), and 150 mM (white square). The standard deviations increased significantly above the ionic strength of 70 mM (white symbols). Therefore, the error bars were omitted in A and plotted separately over a logarithmic scale in B.

References

(1) Gimsa, U., Gimsa, J. Determination of viral neuraminidase specificity for membrane-bound sialic acids by cell electrophoresis. *Mol. Membr. Biol.* **2009**, *14*, 87–90.

(2) Donath, E., Voigt, A. Electrophoretic mobility of human erythrocytes. On the applicability of the charged layer model. *Biophys. J.* **1986**, *49*, 493–499.