Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Mapping surface charge density with a scanning nanopipette
LASSE HYLDGAARD KLAUSEN, THOMAS FUHS, FLEMMING BESENBACHER, MINGDONG DONG, Interdisciplinary Nanoscience Center, Aarhus University, Denmark — Characterisation of the surface charge density (SCD) is important in interface and colloid science, and especially local variations in SCD of biological samples are of keen interest. The surface charge of lipid bilayers governs the uptake of charged particles and guides cell-cell interactions. As the electrostatic potential is screened by high physiological salt concentrations, direct probing of the potential can only be performed at a sub nanometer distance; therefore it was impossible to directly measure the SCD under physiological conditions. Yet the charged surface attracts counter ions leading to an enhanced ionic concentration near the surface, creating a measurable surface conductivity. In this study we measure SCD using a scanning ion-conductance microscope (SICM) setup, where the electrolyte current through a nanopipette is monitored as the pipette is positioned in the vicinity of the sample. We investigate the current dependency of SCD and pipette potential using numerical solutions to Poisson and Nernst-Planck equations and characterise a complex system governed by a multitude of factors such as pipette size, geometry and charge. We then propose an imaging method and prove its feasibility by mapping the surface charge density of phase separated lipid bilayers.

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Date submitted: 14 Nov 2014 Electronic form version 1.4