Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Charge inversion at ultra-low electrolyte concentrations[1] DUNCAN J. MCGILLIVRAY, MATHIAS LÖSCHE, Dept of Physics, Carnegie Mellon University & CNBT, NIST Center for Neutron Research, JENS PITTLER, Dept of Physics, University of Leipzig, Germany, WEI BU, ALEX TRAVESSET, DAVID VAKNIN, Ames Lab & Dept of Physics & Astronomy, Iowa State University — Synchrotron x-ray reflectivity studies of the anionic phospholipid DMPA in monolayers spread on very dilute solutions of $LaCl_3$ reveal strong adsorption of the cations at nanomolar and micromolar concentrations, and a sharp transition in cation concentration at the interface as a function of ionic strength. Using anomalous X-ray reflection we determine the number of La^{3+} ions per $DMPA^-$ (surface charge density, $\sigma \approx e^-/40$ Å^2) over four orders of magnitude in bulk ion concentration. We find that at concentrations in the range 10–300 nM La^{3+} forms a Stern layer with ≈ 1 La^{3+}/ 3 $DMPA^-$, thus neutralizing the lipid surfaces charge. At a critical bulk concentration, $C_t \approx 500$ nM, the surface concentration of La^{3+} increases steeply, up to a saturation level with ≈ 1 La^{3+}/ DMPA. The strong condensation of La^{3+} above C_t implies that the charge at the interface is reversed. We provide theoretical arguments that the charge reversal is facilitated by 1) strong correlations between the phosphate groups and La^{3+} ions and 2) hydrogen bonding of hydroxyl groups, effectively forming the complex $La^{3+}PO_4^{2-}OH^-$.

[1]Supported by DOE W-7405-Eng-82 & W-31-109-Eng-38; NSF-CTS-0304062; NSF-DMR-0426597; NIH 1R01 RR14812

Mathias Lösche
Department of Physics, Carnegie Mellon University and CNBT at the NIST Center for Neutron Research

Date submitted: 06 Dec 2005 Electronic form version 1.4