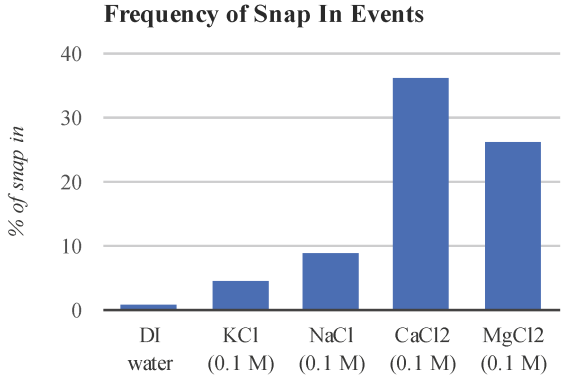
The influence of ions on the hydrophobic interactions of benzene

S. DOBBERSCHÜTZ[1], M. RIMMEN[1], T. HASSENKAM[1], M. P. ANDERSSON[1] AND S. L. S. STIPP[1]

[1]Nano-Science Center, Department of Chemistry, University of Copenhagen, Universitetsparken 5, 2100 Copenhagen Ø, Denmark, sdobber@nano.ku.dk

Hydrophobic interactions between aromatic compounds play a role in biological processes, groundwater contamination and enhanced oil recovery, among others. In crude oil, aromatics usually make up 3 to 30% by weight. To increase the productivity of current oil reservoirs, one tries to understand how to influence the molecular interactions that keep the oil molecules at mineral boundaries.

We were specifically interested in the interaction of benzene compounds. We investigated the effect of the cations present in 100 mM aqueous solutions of the four salts: KCl, NaCl, $MgCl_2$ and $CaCl_2$, on the hydrophobic interaction between benzene terminated self assembled monolayers. By using atomic force microscopy and the jump to contact of the tip to the sample, we determined the effect of the ions on the attractive forces. The various ions influence the frequency of the snap in (shown in the figure) as well as the distribution of the snap in distance. The monovalent ions have lower frequency and narrower distribution. This can be explained by the accumulation of charge on the surfaces, as well as the influence of the ions on the creation of vapour capillaries that bridge between the tip and the surface. The results show how ions can influence long range hydrophobic interactions.



Frequency of the snap in for experiments with deionized water and 100 mM solutions of KCl, NaCl, $CaCl_2$ and $MgCl_2$.