Experimental report

18/09/2018

Proposal:	**9-10-1545**	**Council:**	4/2018
Title:	Adsorption of an anionic surfactant on anionic surfaces in the presence of mono and divalent ions		
Research area:	Chemistry		

This proposal is a new proposal

Main proposer:	**Fin ALLEN**
Experimental team:	C L TRUSCOTT Fin ALLEN
Local contacts:	Philipp GUTFREUND

Samples: CaCl2
Muscovite mica
NaAOT

Instrument	Requested days	Allocated days	From	To
D17	2	2	13/09/2018	15/09/2018

Abstract:

Muscovite mica is a phyllosilicate mineral with perfect basal cleavage, and because of this ability to generate atomically flat and clean surfaces mica has become a popular substrate for surface investigative techniques. The surface provides a highly charged analogue for the investigation of behaviour on clay surfaces, which are of considerable interest in a number of fields and in particular that of oil recovery. In this proposal, we request beamtime to study the adsorption behaviour of the anionic surfactant bis(2-ethylhexyl) sulfosuccinate (AOT) sodium salt on the anionic mica in the presence of different added counterions. This builds on previous work which has showed the nature of the cation to be key in determining adsorption, and will continue to investigate the issue of cation binding which has been central to many enhanced oil recovery approaches in recent years.

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We have again succeeded in measuring reflectivity from the mica/solution interface utilising the supported mounting technique developed by Browning et al.[1] By using the coherent method of summing data developed by Cubitt et al.[2] the inherent loss of flatness of these substrates when compared to a polished silicon wafer may be partly overcome.

We have discovered that the anionic surfactant AOT will bind to the anionic mica surface in the presence of added Ca^{2+} ions even when the surfactant solution is that of the NaAOT salt with added $CaCl_2$ and at an elevated ionic strength, as shown in Figure 1. This is a development on the previous observation that $Ca(AOT)_2$ solutions would lead to adsorption.[3] The layer was found to be weakly bound and removed even when exposed to a solution of the same ionic strength and Ca^{2+} concentration as that from which surfactant adsorption occurred.

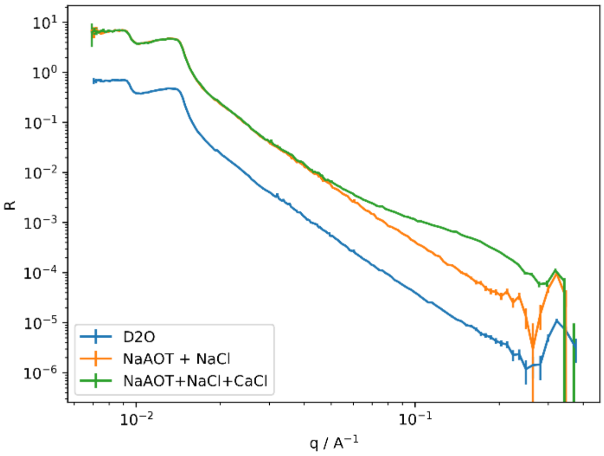

Figure 1: Adsorption of a calcium bridged AOT layer from a mixed sodium calcium salt solution

NaAOT at the CMC with added $MgCl_2$ also leads to adsorption, showing that Mg^{2+} can also act as a bridging ion but the reflectivity profile for the layer formed indicates a different structure to that formed from the Ca^{2+} bridged layer. The Mg^{2+} layer is also easily removed

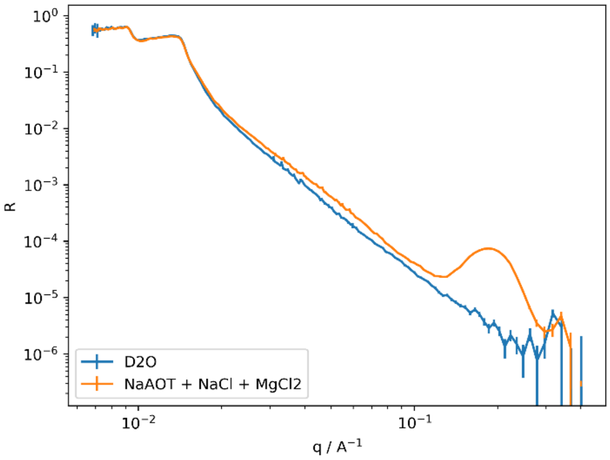

Figure 2: Adsorption of a magnesium bridged AOT layer from a mixed magnesium calcium salt solution, showing a different structure to the calcium bridged layer

References

1. Browning, K.L., Griffin, L.R., Gutfreund, P., Barker, R.D., Clifton, L.A., Hughes, A., Clarke, S.M., 2014. J. Appl. Crystallogr. 47, 1638–1646.
2. Cubitt, R., Saerbeck, T., Campbell, R.A., Barker, R., Gutfreund, P., 2015. J. Appl. Crystallogr. 48, 2006–2011.
3. Griffin, L.R., Browning, K.L., Lee, S.Y., Skoda, M.W.A., Rogers, S., Clarke, S.M., 2016. Langmuir 32, 13054–13064.