Experimental report

06/06/2016

Proposal: **9-12-388** **Council:** 10/2014

Title: Thin Water Layers at the Mica Surface

Research area: Chemistry

This proposal is a new proposal

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Samples: Mica, Water, DDAB, AOT, Heptane

Instrument	Requested days	Allocated days	From	To
D17	3	3	29/06/2015	02/07/2015

Abstract:

This proposal aims to directly address the fundamental physical chemistry of the mica mineral/oil interface. This includes several aspects (i) the oil/mica interface itself (ii) the adsorption (or not) of water at the mica/oil interface and (iii) the binding/ ion exchange/ release of organic species (e.g. surfactants) with and without water. These issues are key in understanding the wettability of mineral surfaces in oil, water and surfactant mixtures for processes in the oil industry and related industries. For example the presence of thin water layers at the mineral surfaces are the basis of a recent innovation in enhanced oil recovery with a value in $billions!

Thin Water Layers at the Mica Surface

Background

This experiment aimed to directly address the fundamental physical chemistry of the mica/oil interface. How and when water is adsorbed by an interface are key issues in understanding the wettability of mineral surfaces in oil and water mixtures for processes in the oil and related industries. Here we apply our technique for neutron reflection from the mica surface to study this behaviour.

Hydrophilic surfaces in oil are thought to hold a water layer at the surface even after significant drying procedures. During this experiment, the surface of mica in oil, with and without water was investigated.

Findings

Neutron reflection is a very sensitive method for detecting thin layers at an interface. Mica has a scattering length density of 3.79×10^{-6} Å^{-2} which is intermediate between h-dodecane and D_2O. Therefore, good contrast between any layers of D_2O entrained by the mica surface against a subphase of h-dodecane is expected. Simulations indicate that a layer as thin as 5 Å should result in a change in the observed reflectivity.

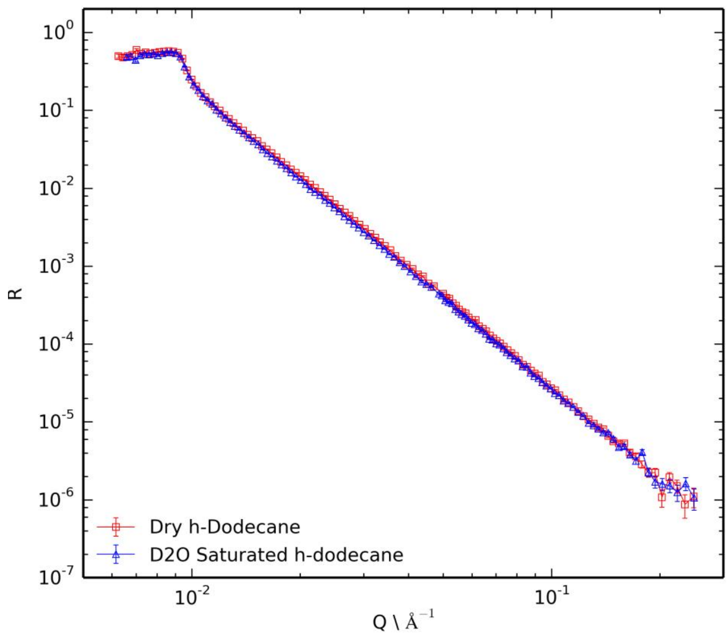

Figure 1: Reflectivity data recorded from the mica surface exposed to dry h-dodecane and D_2O saturated h-dodecane

Mica surfaces for reflection were prepared minimising exposure of the surface to water and characterised in copiously dried dodecane.

Measurement of the surface in D_2O saturated h-dodecane exhibited no change in the reflectivity, as shown in Fig 1. This indicates that water was not measurably entrained to the surface from the oil.

No change in the reflectivity profile was measured after complete exposure of the surface to D_2O and then exposure to h-dodecane without exposing the surface to air. Hence, we conclude no water layer formation is detected. **T**hese measurements show that water can be completely displaced from the mica surface by exchange with dodecane.

We conclude that a hydration layer of water on mica in oil could not be detected using neutron reflection.