Effect of Solvent on the State and Structure of Adsorbed Films of Hydrocarbon Alcohols at Oil/Water Interfaces

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Our previous work on the adsorbed film of 1H,1H,2H,2H-perfluorodecanol (FC10OH) and 1-icosanol(C20OH) at the hexane/water interface by interfacial tension and synchrotron X-ray reflectivity (XR) measurements demonstrated that (1) the adsorbed films exhibit phase transition from expanded to condensed states and (2) the condensed film of FC10OH is two-dimensional solid, while that of C20OH corresponds to a liquid just above the freezing point [1]. This suggests that the solvent – solute interaction as well as solute – solute one affects appreciably the state and structure of adsorbed films at oil/water interfaces. Here we will show some findings obtained by applying both tensiometry and XR techniques to the adsorbed films of hydrocarbon alcohol at the perfluorohexane/water interface in order to know the effect of solvent – solute interaction on the structure of the adsorbed film.

The interfacial tension \( \gamma \) of the perfluorohexane solution of 1-teradecanol (C14OH) against water was measured as a function of temperature \( T \) and molality \( m \) under atmospheric pressure by the pendant drop method. XR measurement was performed as a function of \( T \) and wave vector \( Q_z (= (4\pi/\lambda)\sin\alpha) \) at beamline sector 15 in Advanced Photon Source (Argonne National Laboratory). The wave length was 0.4119 Å.

The interfacial tension \( \gamma \) vs. temperature \( T \) curves show a break corresponding to a phase transition in the adsorbed C14OH film. The interfacial pressure \( \pi \) vs. mean area per adsorbed molecule \( A \) curve consists of two states connected by a discontinuous change. It was found that C14OH molecules can form condensed film at lower concentration at the perfluorohexane/water interface than at the hexane/water interface. This is primarily due to strengthened interaction between C14OH molecules caused by weak interaction of C14OH with perfluorohexane molecules. The electron density of the adsorbed film obtained from XR measurement is higher for the condensed C14OH film at the perfluorohexane/water interface than for the condensed C20OH film at the hexane/water interface; C14OH molecules form two-dimensional solid rotator phase in the condensed film.

Reference