Adsorption structure of stearic-acid molecules on a calcite surface in ethanol and artificial sea water

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Artificial sea water has been considered to improve the oil recovery from chalk. Presence of Ca^{2+}, Mg^{2+}, and SO_4^{2-} ions in the water can improve the oil recovery [1], and the mechanism has been considered by the surface tension alteration induced by these ion substitutions of the calcite surface [2,3]. To confirm the mechanism proposed by these theoretical calculations, it is required to reveal the adsorption structure of oil molecules on a carbonate surface in water.

Here, we conducted the surface X-ray scattering measurements of calcite/oil model compound interface in ethanol and artificial sea water. Stearic acid ($C_{18}H_{36}O_2$) was used as a model compound of oil molecules. These experiments were performed at the KEK-PF BL-4C.

The X-ray scattering intensity of the interface in ethanol oscillated at low momentum transfer (Q) values, which is consistent with the interface in methanol [4]. This oscillation would be ascribed to the presence of stearic-acid monolayer. Such oscillation was observed at the interface in artificial sea water; however, the oscillation period was different from that in ethanol. This indicates that the adsorption structure is altered by the change of solution from ethanol to artificial sea water. The oscillation of the X-ray scattering intensity in the artificial sea water was diminished with time and this can be interpreted by the desorption of stearic acid from the surface owing to the acidification of solution by the X ray [5].

We discuss the adsorption structure of stearic acid and the effect of surrounding solution based on these results and the analysis using a structural model.

References

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Keywords: Electron density, Oil recovery, Salt water, Mineral-water interaction

