

# Nano-sized clusters in the mixture of D<sub>2</sub>O/H<sub>2</sub>O in the presence of 3-methylpyridine

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Mixtures of D<sub>2</sub>O and 3-methylpyridine (3MP) exhibit a closed-loop type on the T- $\phi$  ( $\phi$  is a volume fraction of 3MP) phase diagram and that H<sub>2</sub>O and 3MP mixtures do not phase separate at any temperature. It is also known that the deuteration of water and pressure have opposite effects on the phase equilibrium behavior (Z.P. Visak, et al., *J. Phys. Chem. B*, **107**, 9837 (2003)). These results suggest that the solvation affinities of 3MP with D<sub>2</sub>O and H<sub>2</sub>O are different. However, no definite explanation for this problem exists so far.

Recently, we have performed the preliminary experiment for the mixtures of 3MP and D<sub>2</sub>O/H<sub>2</sub>O are measured by SANS at CG-2, HFIR, Oak Ridge National Laboratory. Then, deuterated 3MP (3MP-d7) was mixed with 95.9 vol% of D<sub>2</sub>O and 4.1 vol% of H<sub>2</sub>O in order to set the mean neutron scattering length density of water being the same as that of d-3MP. When the distributions of D<sub>2</sub>O and H<sub>2</sub>O are homogeneous, no SANS scattering should be observed even if the distribution of d-3MP is heterogeneous. However, the observed SANS profile indicate the strong scattering centered at  $q=0$ . The profile could be explained by a scattering function from spherical particles with Schultz size distribution. The radius of spherica clusters are about 400 Å. This result indicates that the demixing of H<sub>2</sub>O and D<sub>2</sub>O is induced by the effect of d-3MP.

In order to confirm this result, we again performed the SANS measurement at SANS-U. Wavelength of incident neutron was 4.8 Å, the beam size was 5mm and the distance between the sample position and the 2D detector was 2m/12m. The sample was contained in a quartz cell of 4mm-t. Unfortunately, no clear profiles were observed in this case since the scatter-

ing intensity was too weak. Therefore, further measurements should be done by using higher flux neutron beam.

Neutron Spin Echo experiments are performed at iNSE in the mixture of water, 3MP and NaBPh<sub>4</sub>. The intermediated correlation function can be interpreted with the model proposed by Zilman and Granek. This evidence verifies the formation of the membrane-like structure by adding NaBPh<sub>4</sub>.

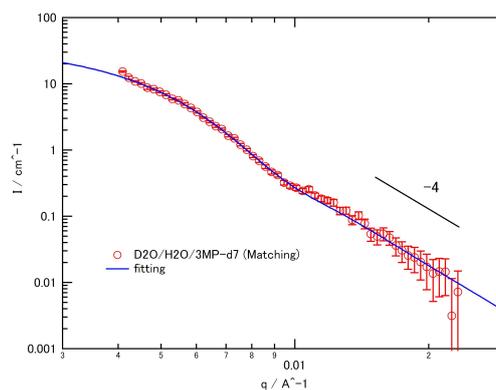


Fig. 1. SANS profile of water(D<sub>2</sub>O+H<sub>2</sub>O)/3-methylpyridine.