実験報告書様式（トライアルユース）

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CROSS TOKAI **Experimental Report** J-PARC	**承認日** Date of Approval 2015/1/4 **承認者**Approver Jun-ichi Suzuki **提出日**Date of Report 2014/5/19
課題番号 Project No. 2013B0106 実験課題名 Title of experiment Anomalous Reaction Environment Composed of Magnetically-Aligned Colloidal Assemblies 実験責任者名 Name of principal investigator Masataka OHTANI 所属 Affiliation RIKEN	装置責任者 Name of Instrument scientist Hiroki Iwase 装置名 Name of Instrument/(BL No.) BL15 TAIKAN 実施日 Date of Experiment 2014/03/06 ～ 2014/03/07 2014/03/13 ～ 2014/03/14

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。（適宜、図表添付のこと）

Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.

Carbon nanotube micellar dispersion (SWNT@MSC) was used to measure the small-angle neutron scattering. Dispersion was prepared by mixing a powder sample of single-walled carbon nanotube and cholate-based surfactant with ultrasonication ($C_{57}H_{93}N_6O_{17}Na$) in D_2O or H_2O. The dispersion sample was placed in 1-mm or 2-mm quartz cuvette.

2. 実験方法及び結果 （実験がうまくいかなかった場合、その理由を記述してください。）

Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.

To confirm the magnetic effect on the dispersed structure of carbon nanotube micelles, we performed the small-angle neutron scattering experiment with applying the strong magnetic field. The SANS experiment was carried out at BL-15 TAIKAN in Materials and Life Science Experimental Facility (MLF) of Japan Proton Accelerator Research Complex (J-PARC). The magnetic field was applied using a vertical superconducting magnet apparatus (maximum field strength, 10 T; JASTEC). During the experiment, sample cuvette was fixed in the magnet bore. The magnetic field was gradually applied from zero to 10 Tesla within 1 hour. The SANS profiles was collected with 2D detector in wide q range of 0.005-10 $Å^{-1}$. The experiment was performed at room temperature. The glassy carbon and pure D_2O and H_2O were used as a reference sample for background correction.

2. 実験方法及び結果（つづき） Experimental method and results (continued)

Figure 1 shows the overall scattering profiles of carbon nanotube micellar dispersion in the presence and absence of the 10-Tesla magnetic field. In the middle and high-q region ($0.04 < q < 10$ Å^{-1}, Figure 1a), scattering profiles did not seem to change whether the magnetic field was applied or not. Similar scattering profile for the nanotube micelle sample was reported in previous literature.[1] Thus, this indicates the form factor of worm-like nanotube micelle was not affected by treatment with the strong magnetic field. On the other hands, we found slight but significant changes in the low-q region. Upon applying the magnetic field, scattering intensity was obviously decreased ($0.005 < q < 0.04$ Å^{-1}, Figure 1b). It is also worth noting that this tendency was also seen in additional magnetic experiments using diluted dispersion of the same nanotube micelle. One of the plausible explanation for the observed magnetic effect is as follows: (i) in the absence of the magnetic field, there are a number of entanglement point due to the overlapping of the micellar structure. (ii) Upon magnetic exposure, the nanotube micelle is forced to align parallel to the direction of magnetic flux. Such aligned structure may cause the effective like-charge repulsion between the nanotube micelles, resulting in the decreasing of micelle entanglement. In fact, such intensity change in the low-q region was also reported previously.[2] Although we need further experiment to clarify the detailed mechanism of the magnetic effect on nanotube micelle, these findings opens new perspectives in understanding the magnetic effect in condensed soft matter system.

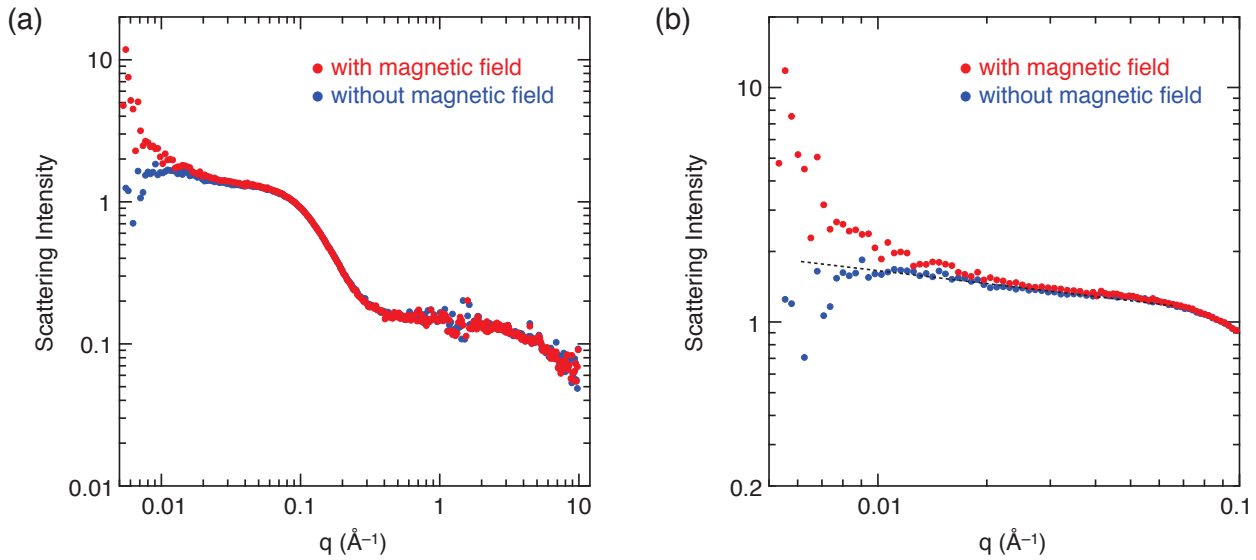

Figure 1. SANS profiles of 10 wt % SWNT@MSC dispersion in D_2O in the presence (red circles) and absence (blue circles) of the 10-Tesla magnetic field: (a) overall scattering profile ($0.005 < q < 10$ Å^{-1}) (b) the magnified profiles at low-q region ($0.005 < q < 0.1$ Å^{-1}).

(Reference)

1. Hough, L. A., Islam, M. F., Hammouda, B., Yodh, A. G., Heiney, P. A. Structure of Semidilute Single-Wall Carbon Nanotube Suspensions and Gels. *Nano Letters*, **2006**, *6*, 313–317.
2. Roux, J.-N., Broseta, D., Demé, B. SANS Study of Asphaltene Aggregation: Concentration and Solvent Quality Effects. *Langmuir*, 2001, *17*, 5085–5092.