Crowding effect on the shear induced structural transition of lamellar phase

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It is well known that the shear flow applied on a lyotropic lamellar phase induces an onion (multilamellar vesicle) structure. Although it is also well known that polymers grafted on the lamellar membrane affect its dynamics, much less is known how the grafted polymer chain influences the viscoelasticity of lamellar phase, especially how the shear induced lamellar to onion structural transition is influenced by grafted polymer chain. On the shear induced lamellar to onion transition for the polymer-grafted lamellar phase, we should clarify the bilayer membrane structure in the microscopic scale.
In the present study, we have measured the small angle neutron scattering (SANS) on the polymer-grafted lamellar phase in D2O under shear flow field. Samples used in this study were nonionic surfactant (C10E3)/PEO-PPO-PEO type amphiphilic triblock copolymer (P105)/water system. Triblock copolymer concentration was fixed to the mole fraction of 0.01.

The Rheo-SANS measurements were performed by using SANS-U spectrometer equipped with quartz Couette shear cell at Institute for Solid State Physics, The University of Tokyo in JRR-3M at Tokai. Fig.1 shows the SANS profiles for surfactant lamellar and polymer-grafted lamellar phases at shear rate of 50s-1. For the surfactant lamellar phase (fig.1a), SANS profile shows an Onion formation with one Bragg peak. However, for the polymer-grafted lamellar phase (fig.1b), no Onion formation is observed but SANS profile shows the emergence of the second Bragg peak, which indicates the lamellar-lamellar phase separation. Thus, the present results suggest that lamellar-lamellar phase separation significantly affects the shear-induced Onion formation behavior.

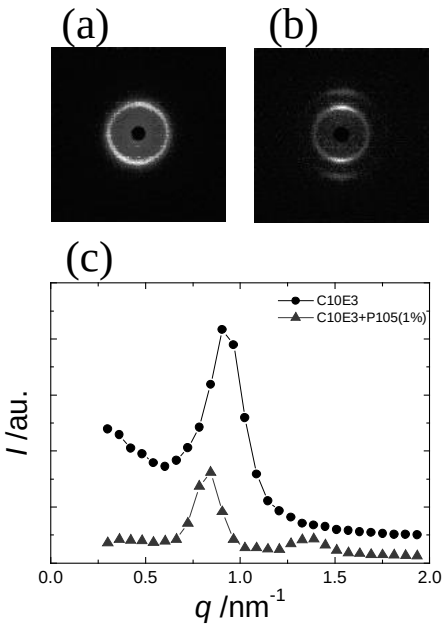

Fig. 1. SANS profiles of the surfactant lamellar and polymer-grafted lamellar phases.