Shear induced structures in lamellar systems: from layers to onions to onions and layers

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The shear induced size evolution of multilamellar vesicles (MLV, “Onions”) of a non-ionic surfactant system composed of 40wt% $C_{10}E_3$ in D_2O was investigated with the help of Rheo-Small Angle Neutron Scattering (SANS), Rheo-Small Angle Light Scattering (SALS) and optical microscopy. We will especially discuss shear quench experiments, i.e. when the shear rate is reduced. Two different pathways were observed. A continuous growth of vesicle size was found when the shear rate was reduced within the stability region of monodisperse MLV (Region III). However, a discontinuous pathway was observed for shear quenches from the monodisperse into the polydisperse MLV region (Region II). A shear quench into the high shear rate part of region II leads to a formation of lamellar domains which themselves follow the pathway of MLV formation in coexistence to the initial MLV structure. A shear quench into the low shear rate part region II leads to the formation of lamellar macro-domains, which display a tumbling behaviour and grow with time until the MLV formation process starts.

In the second part of this contribution, we will discuss the influence of nonionic polymers on the phase behavior and the shear induced formation of multilamellar vesicles. Increasing polymer content lead to a shift of phase transitions to lower temperatures, and the MLV formation occurs at higher shear rates.