

Experimental Details:

Small-angle X-ray scattering (SAXS)

Scattering measurements were performed on the small-angle scattering instrument at SAGA synchrotron facilities (Synchrotron SAGA, Tosu, Kyushu, Japan) and in a Bruker nanostar SAXS machine in the University of Kyushu (Onojo Campus). The LC mixtures were introduced in a house lab cell. The available scattering vector q range was between $1.02 \cdot 10^{-2} \text{ nm}^{-1}$ and 1.571 nm^{-1} for SAGA SAXS and between $1.0 \cdot 10^{-2} \text{ nm}^{-1}$ and 0.23 nm^{-1} for the lab SAXS machine in the University of Kyushu respectively. This scattering vector q is calculated by the following equation:

$$q = \frac{4\pi \sin \theta}{\lambda}$$

where 2θ is the scattering angle and λ is the wavelength ($\lambda=1.418 \text{ \AA}$) for both spectrometers. Several successive frames of 1800s each were recorded for each sample. A check for radiation damage or sample evolution was performed and no difference between frames was found unless otherwise specified. Each frame-averaged scattering spectrum was corrected for the detector response and scaled to the transmitted intensity, using the scattering intensity from a reference glassy carbon sample integrated over a given angular range. Standard deviations of each measurement were computed as the square root of the number of detected photons.

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Fourier transform infrared (FTIR) measurements in the range $650\text{-}4000 \text{ cm}^{-1}$, were recorded using a Thermo Nicolet 6700 FT spectrometer equipped with a Deuterated Triglycine Sulfate (DTGS) detector and a Nicolet Continuum microscope. The LC mixtures were spread over an ZnSe window of the microscope. The analyzed sample area was a square of side $100 \text{ }\mu\text{m}$ chosen under the microscope 15X Infinity Reflexchromat objective. The analyses were performed in transmission mode and each spectrum was the average of 256 scans collected at 1 cm^{-1} resolution.

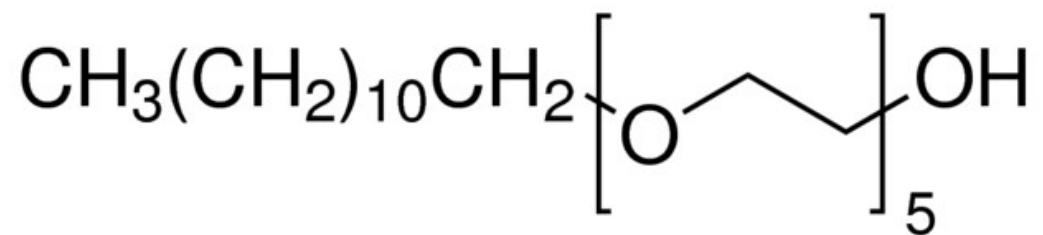


Figure S1: Chemical structure of the pentaethylene glycol monododecyl ether nonionic surfactant, abbreviated as C₁₂E₅.

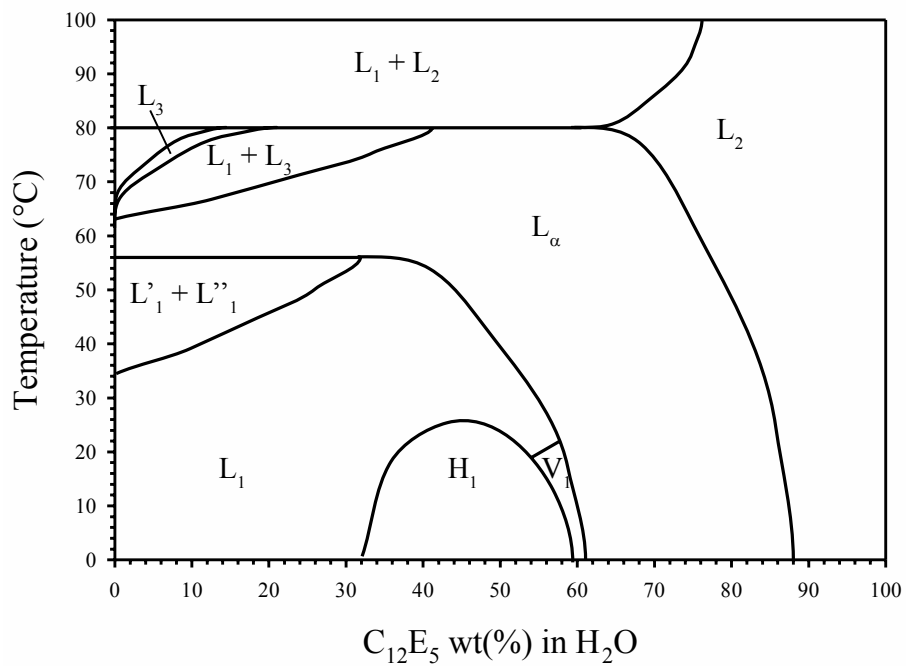


Figure S2: Temperature-Concentration phase diagrams of C₁₂E₅-H₂O surfactant-water system. L₁ and L₂ correspond to a spherical and reverse micelle phases whereas H₁, V₁ and L_α refer to hexagonal, cubic and lamellar (self-assembled) phases

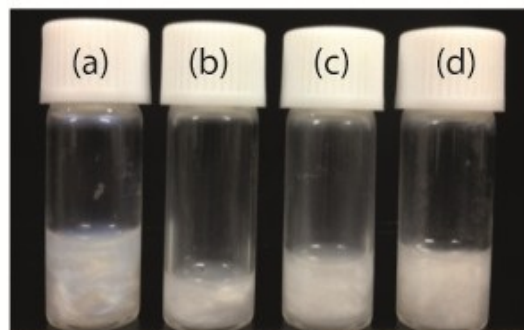


Figure S3: Pictures of the prepared samples obtained by mixing niobate nanosheets at a concentration of 20 g/L^{-1} (a) and nonionic surfactants at a mass fraction of 0.15 (b), 0.25 (c), and 0.4 (d).

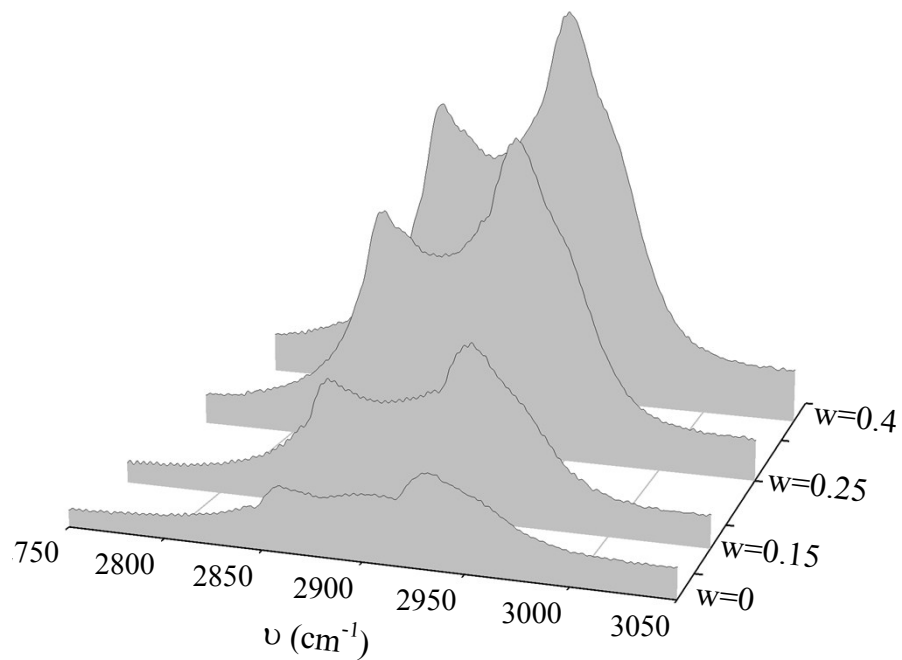


Figure S4: Symmetric and asymmetric CH₂ stretching bands whose wave numbers indicate the presence of disorder / order in the alkyl chains. These two CH₂ stretching bands appear at wave numbers, which are coherent to an all-trans conformation for the nonionic surfactants. Moreover, the integrated intensity of these bands is proportional to the density of surfactants.

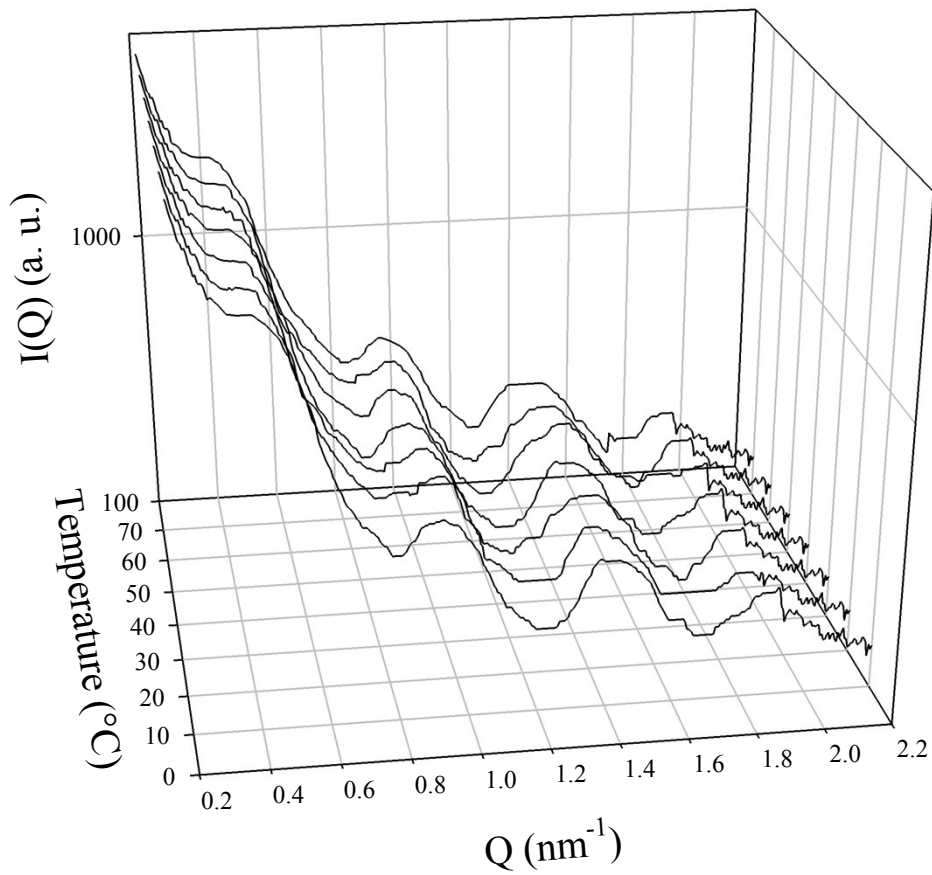


Figure S5: temperature dependence of the Small Angle X-ray Scattering (SAXS) profiles of niobate nanosheets at a mass concentration of 2% and with C_{12}E_5 nonionic surfactant at a mass concentration of $w=0.15$ for the temperature range 10-70°C.