Electronic Supplementary Information (ESI)

Hydrophilic nanoparticles stabilising mesophase curvature at low Concentration but disrupting mesophase order at higher concentrations

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S1. Example 2D and 1D scattering patterns of the mesophases observed

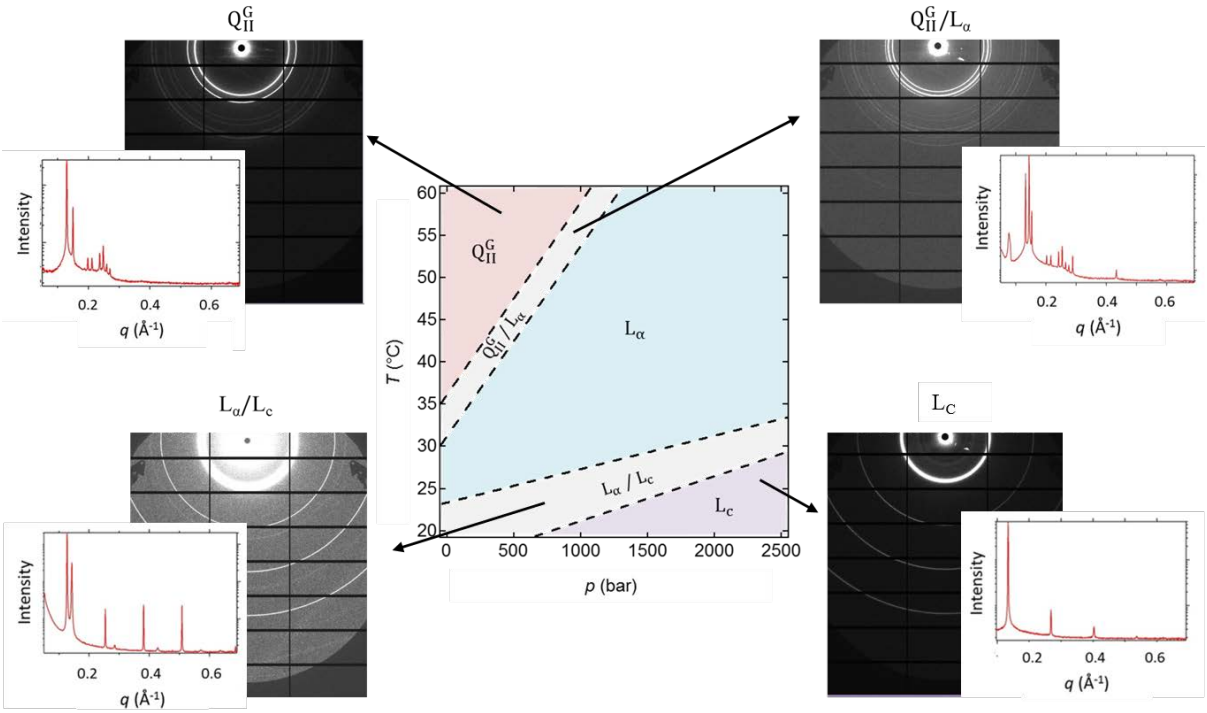

Figure S1 *p-T* phase diagram of MO at 18 wt% hydration without the presence of NPs (Figure 2), with both the 1D scattering pattern and the 2D image of the scans used to identify the mesophases.

S2. SAXS scans of MO at 18 wt% hydration with 10 nm SiO_2 NPs

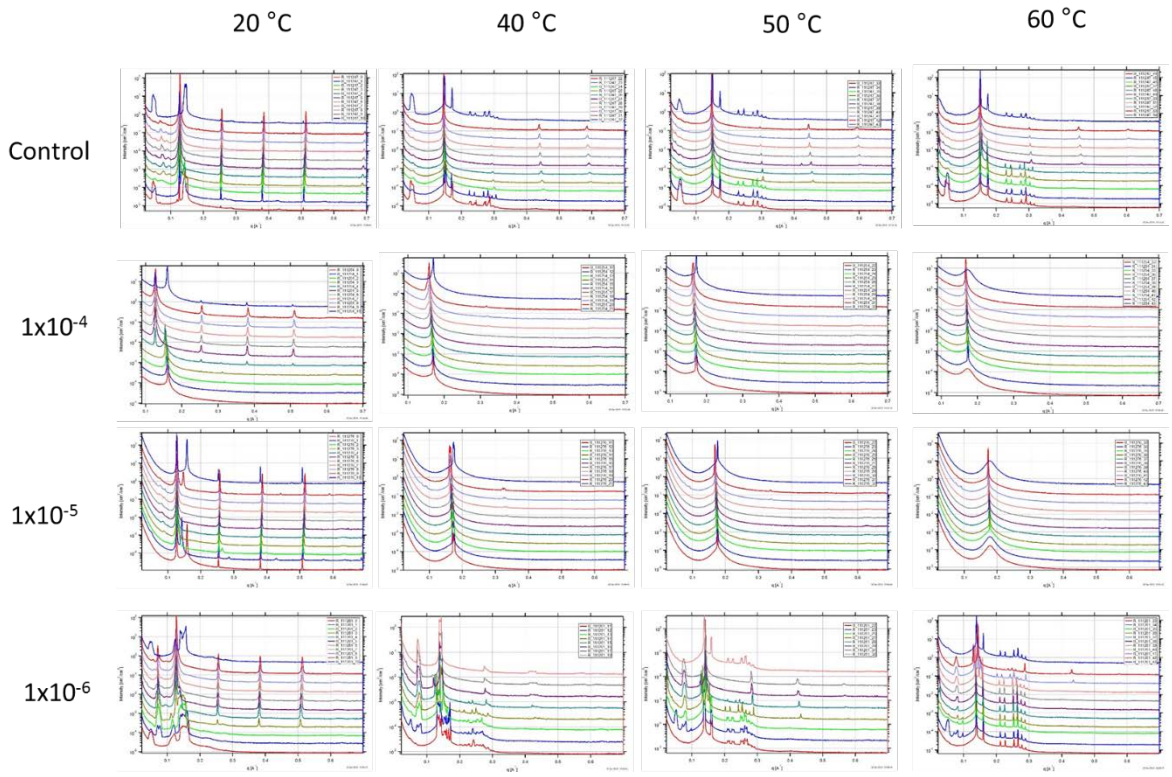

Figure S2 Complete SAXS scans for the MO mesophase samples without any silica NPs (controls) and in the presence of 10 nm silica NPs at NP/lipid ratios ν of 1×10^{-4}, 1×10^{-5} and 1×10^{-6}. Measurements were made at 20, 40, 50 and 60 °C between 1 -2700 bar at 300 bar intervals. The vertical scale of the curves has been displaced for clarity.

S3. *d*-spacing vs pressure of MO mesophases

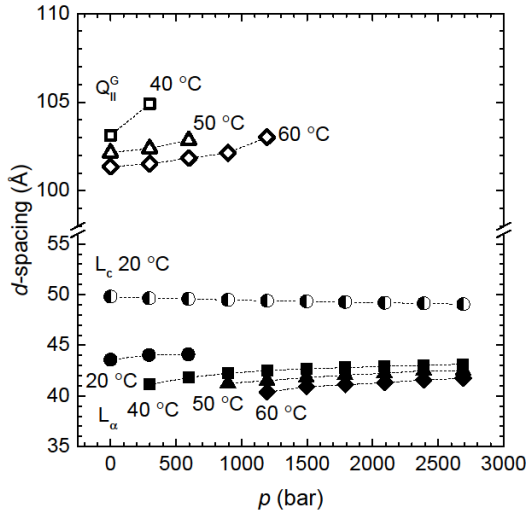

Figure S3 *d*-spacing *vs* pressure *p* for the MO L_α (filled symbols), L_c (partially filled circles) and Q_{II}^{G} (hollow) mesophases. The *d*-spacing for the lamellar phase is ~half of the Q_{II}^{G} mesophase.

S4. Determining the uncertainty in the *d*-space value

The *d*-spacing (*d*) of the mesophase structure can be determined from *q*

$$d = \frac{2\pi}{q} \quad \text{(Eqn S1)}$$

With *q* the only variable, the error or uncertainty in *d* (σ_d) can be determined from *q* and the error in *q* (σ_q) as

$$\frac{\sigma_d}{d} = \sqrt{\left(\frac{\sigma_q}{q}\right)^2} \quad \text{(Eqn S2)}$$

which can be simplified to

$$\frac{\sigma_d}{d} = \frac{\sigma_q}{q}. \quad \text{(Eqn S3)}$$

Thus

$$\sigma_d = \frac{\sigma_q * d}{q} \quad \text{(Eqn S4)}$$

For example, for the measurements made at 1 bar and 20 °C in an NP free MO sample with *q* measurements taken at every 0.0001 Å^{-1}, the σ_d for the L_α and L_c phases are

$$(L_\alpha) \quad \sigma_d = \frac{0.00005 * 49.795}{0.1262} = 0.02 \text{ Å}$$

$$(L_C) \quad \sigma_d = \frac{0.00005 * 43.573}{0.1442} = 0.015 \text{ Å}$$

S5. Contrast matched SANS scans of MO mesophases containing silica NPs

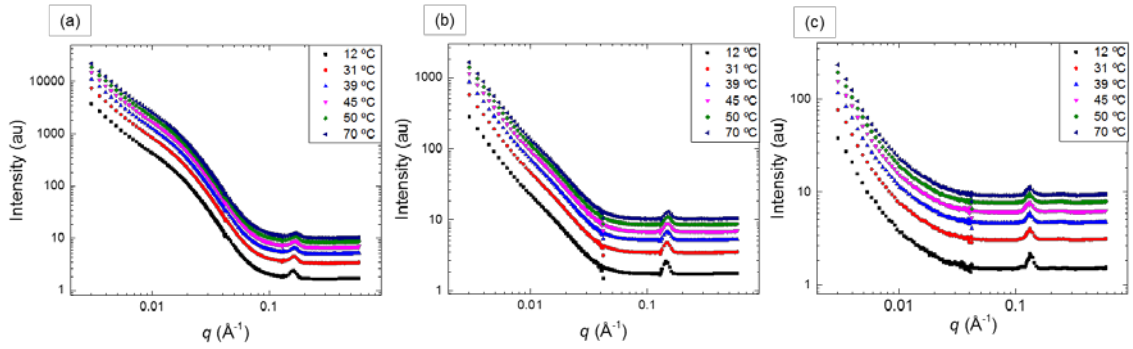

Figure S4 All contrast matched SANS curves at 12, 31, 39, 45, 50 and 70 °C, at NP/lipid number ratios ν of (a) 1×10^{-4}, (b) 1×10^{-5} and (c) 1×10^{-6}. Scans measured for a certain NP/lipid ratio were highly reproducible.

S6. SEM images of sintered mesophase samples

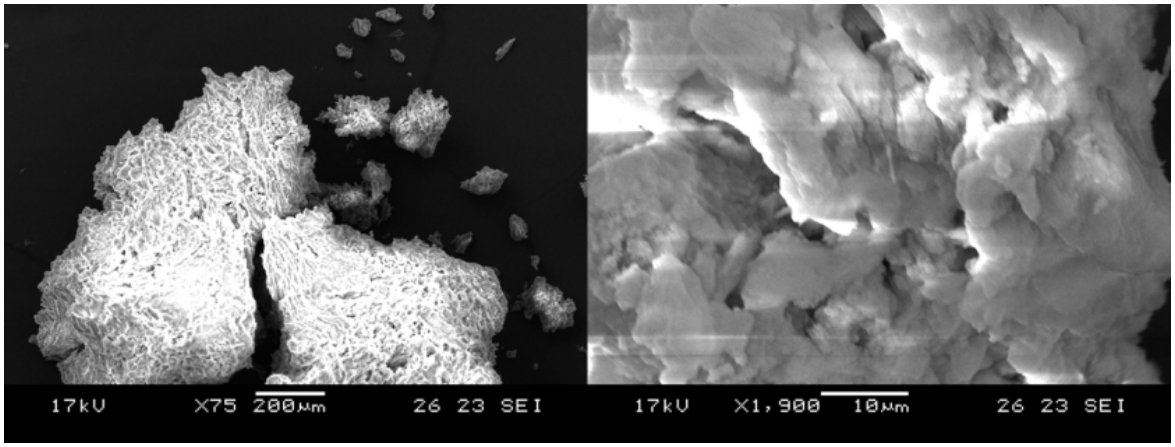

Figure S5 SEM images of an MO mesophase sample containing NPs at $v = 1\times10^{-4}$ after removing the water and MO by sintering the sample at 600 ºC. The remaining silica NPs formed a porous network.