

# Supplementary Data: Non-degenerate magnetic alignment of self-assembled mesophases

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POM measurements were carried out using a Zeiss Axio Observer microscope equipped with a Pike CCD camera. Samples were confined between two thin glass slides separated by a silicone rubber spacer and placed on a temperature controlled stage (Linkam). Observations were made in transmission under crossed polarizers at 50x magnification. Prior to the measurement, two cycles of heating to 70°C and cooling to room temperature were performed in order to ensure reproducibility. The evolution of the birefringent textures of the sample was recorded during heating at 1 °C/min. Data was analyzed using ImageJ software to extract the spatial mean intensity of transmitted light as a function of temperature for determination of the “clearing point” or order-disorder transition.

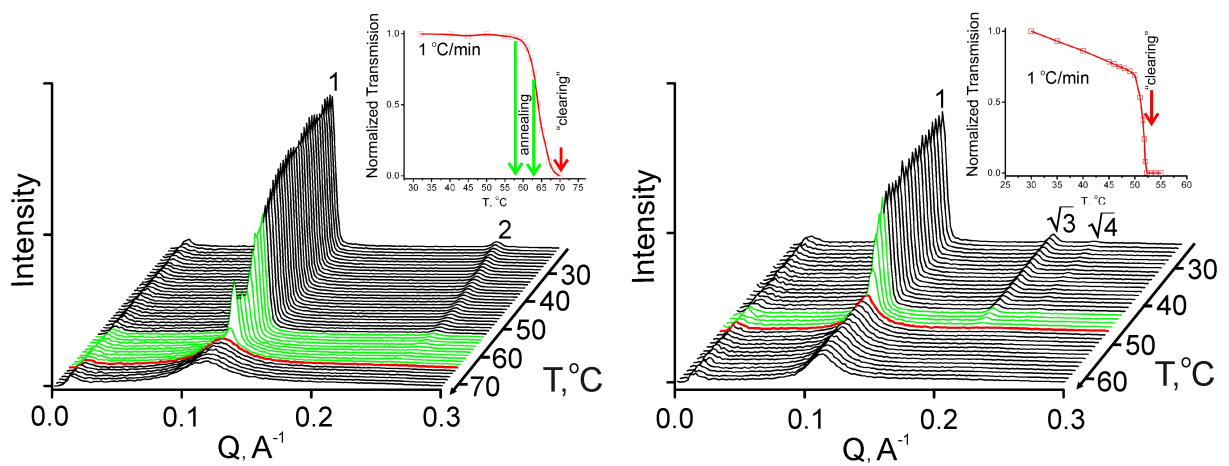
SAXS studies were performed on a Rigaku instrument (S-Max3000) using pinhole collimation of Cu K $\alpha$  radiation and equipped with a 2-dimensional gas-wire detector. Samples were placed between two Kapton foil windows sealed with a 1mm thick rubber o-ring in a liquid-thermostated aluminum holder. They were subjected to an initial heating and cooling cycle from 25 to 70 and back to 25 °C to ensure a reproducible initial state, following which temperature resolved scattering was performed in 1 °C increments with 100 s acquisition times from 25 to 70 °C. Order parameters,  $\langle P_2(\cos \alpha) \rangle_d$ , referred to for brevity as  $P_2$  were determined by integration of the azimuthal dependence of the scattered intensity, according to Equation 1 where  $\alpha$  is the azimuthal angle.

$$\langle P_2(\cos \alpha) \rangle = \frac{\int_0^{\frac{\pi}{2}} I(q, \alpha) \frac{(3 \cos^2 \alpha - 1)}{2} \sin \alpha d\alpha}{\int_0^{\frac{\pi}{2}} I(q, \alpha) \sin \alpha d\alpha}$$
$$\langle P_2(\cos \alpha) \rangle_d = \langle P_2(\cos \alpha) \rangle / (-1/2) \tag{1}$$

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**Fig. 1** Temperature dependent SAXS and polarized optical microscopy (inset) of LAM (left) and HEX (right) mesophases. The transition to disordered micelles occurs in the temperature range highlighted by the green lines. There is a small  $\approx 3\text{-}5$  °C difference in  $T_{ODT}$  determined by SAXS vs POM (higher).