Supplementary Information

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1. SANS Instrument Configurations

The SANS instrument configurations employed at NCNR and HANARO are summarized in Table S1.

2. POM Measurements

The POM image of CoS12 measured at 80 °C shows the focal conic texture of typical columnar hexagonal liquid crystalline phase (Fig. S1).

3. X-ray Diffraction Measurements

The structure of CoS12 in the solid phase was examined by X-ray powder diffraction measurements which were performed with a D/MAX-IIIC θ-2θ goniometer employing Cu Kα radiation. The samples were cooled from the isotopic phase in the same manner as the SANS measurements. The source current and voltage were regulated at 45 mA and 40 kV. Monochromic radiation was obtained by employing a graphite filter on the diffracted beam and the X-rays were detected with a NaI scintillation detector. Peak widths were corrected for instrumental resolution. Pattern indexing was performed with

the Chekcell software package. We emphasized the first diffraction peaks ($2° < 2\theta < 30°$) in our indexing procedures.

The diffraction pattern of CoS12 in the solid phase, which is indexed to the P2 plane group, is depicted in Fig. S2. The indexing parameters are a=50.7 Å, b=31.3 Å and γ=50 degree (γ is an angle between a and b). The reflection (*h k*) = (-2 0) is consistent with the intercolumnar distance measured by cryo-TEM (*d* = 20 Å). The two high angle peaks around *d* = 4.5 Å position may be attributed to an intracolumnar periodicity of alkyl chains. The peak around *d* =3.7 Å position may be related to the cofacial distance of aromatic core.

4. Temperature dependence of magnetic alignment measured by SANS

The temperature dependence of magnetic alignment of CoS12 was measured by SANS. CoS12 was cooled from the isotropic phase to the liquid crystalline phase in the presence of an applied magnetic field of 1.0 T. The annular averages (taken at Q=0.26 $Å^{-1}$) of the SANS intensities measured at different temperatures are shown in Fig. S3. It is clear that the anisotropies of SANS intensities are markedly increased as the temperature is decreased within the liquid crystalline phase region.

Supporting Table

Table S1. Configurations of SANS instruments

Spectrometer	Wavelength(λ) / FWHM(δλ/λ)	Source / Sample aperture diameter (mm)	Source-to-sample / Sample-to-detector distance (m)	Detector tilting or offset
NG3 at NCNR	4.45Å / 0.167	50.8 / 9.5	5.47 / 1.87	offset by 20 cm
NG7 at NCNR	5.0Å / 0.11	50.8 / 9.5	5.42 / 1.05	None
8 m SANS at HANARO	4.31Å / 0.10	32 / 8	4.5 / 2.0	tilted 2.5° and offset by 20 cm

Supporting Figures

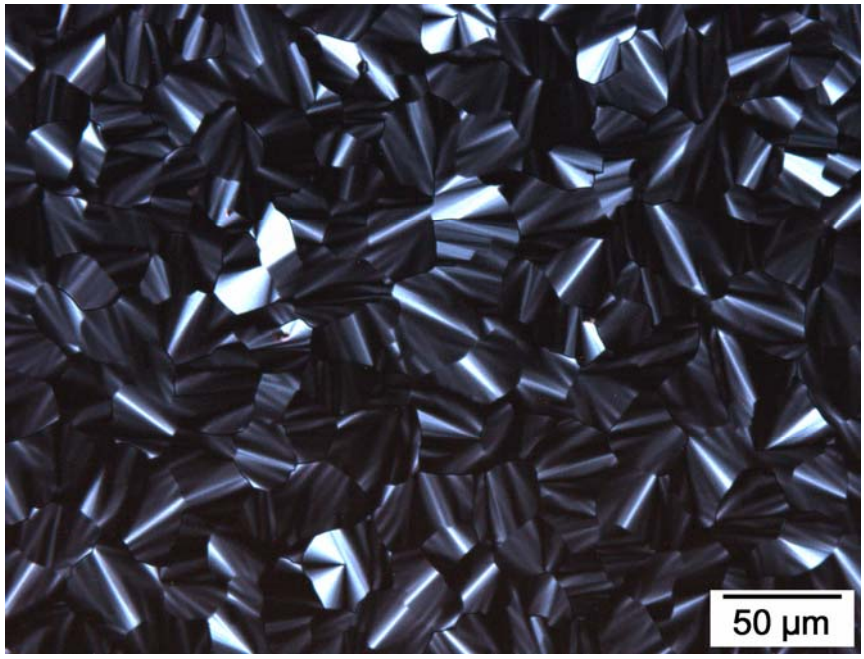

Fig. S1. (a) Optical texture of CoS12 at 80°C under cross polarizers, in its columnar hexagonal columnar LC phase, was measured upon cooling with the rate of 1°C/min.

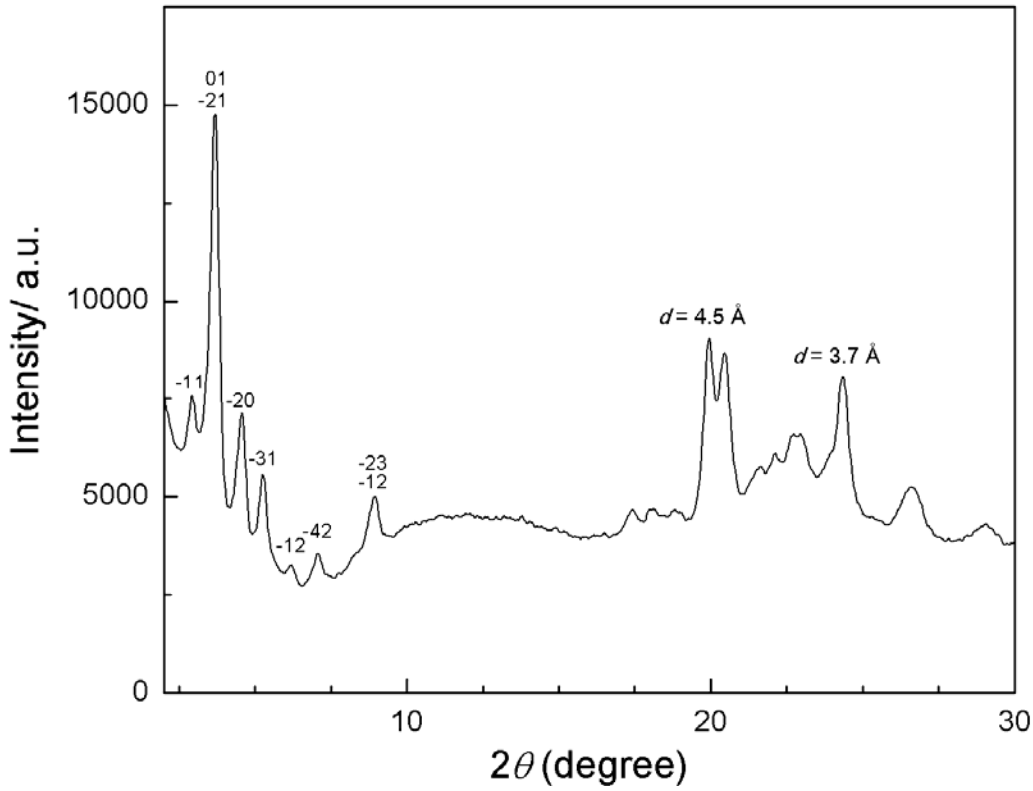

Fig. S2. 1D X-ray diffraction pattern of CoS12 measured at 25°C (solid phase).

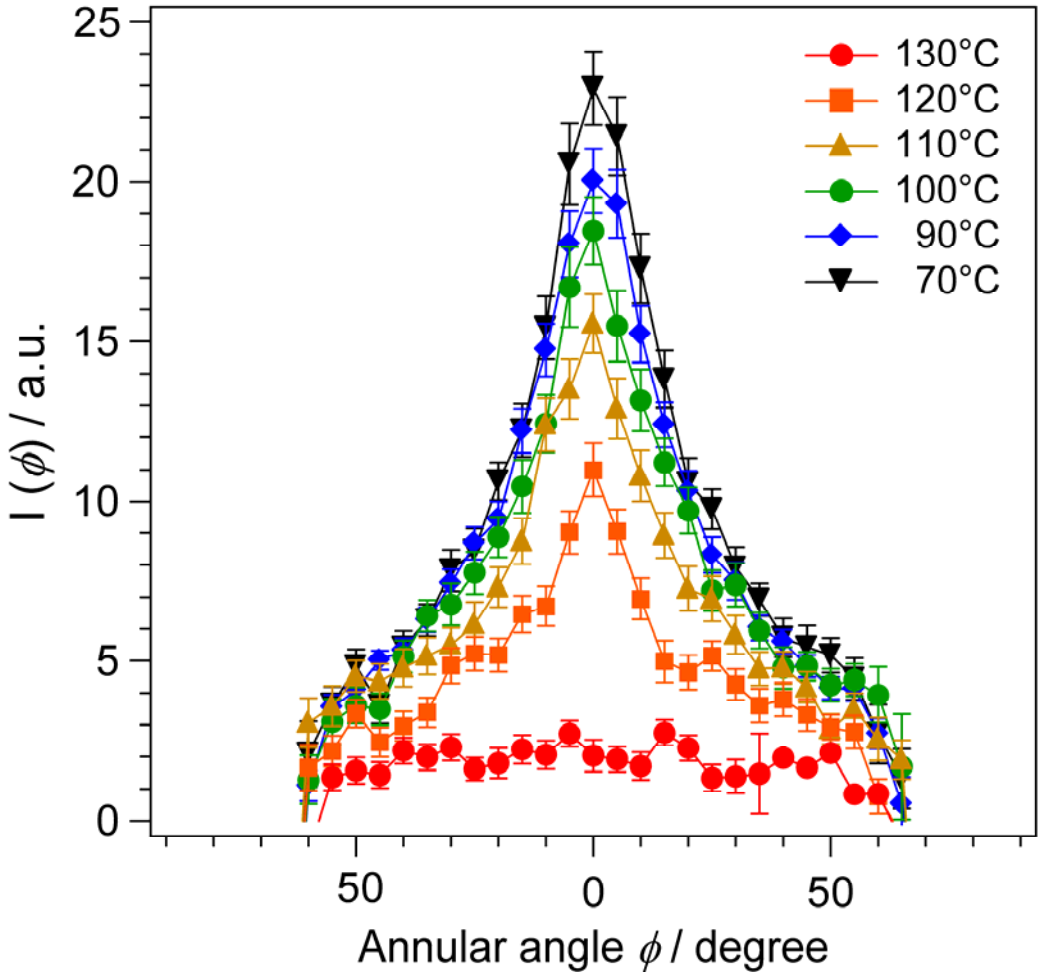

Fig. S3. Annular averaged SANS intensities of CoS12 measured at different temperature in the presence of an applied magnetic field of 1.0 T. The measurements were performed during cooling from the isotropic phase.