

Monodisperse Nanosheet Mesophases

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Inorganic nanosheets obtained by exfoliation of layered crystals are known to form intriguing colloidal liquid crystals (LCs). They have been applied for fabrication of anisotropic polymer composite materials, structural color materials, etc. However, large polydispersity in lateral size of the nanosheets limited precise design of self-assembled structures and materials design.

Here, we demonstrate that very unusual mesophases are reversibly formed by self-assembly of anionic *monodisperse* nanosheets (mNS) in combination with various cationic species (Fig. 1).^[1] In an as-prepared tetramthylammonium (TMA)/mNS aqueous dispersion, mNSs with the thickness of 0.65 nm and the lateral size of 14 nm were isotropically and uniformly dispersed. As [mNS] and [TMA] increased, one-dimensional columnar nanofibers (CoINF) formed; the CoINF was composed of alternating stacking of TMA and mNS with the periodic distance of 1.7 nm as revealed by small angle X-ray scattering (Fig. 2) and transmission electron microscopy. The CoINFs formed fluid columnar nematic LC phase as observed by crossed polarizer observation. Crystalline fibrous bundles of CoINF were also formed. The formation and dissociation of these mesophases were reversible and controllable by many factors such as solvent composition, kind of interlayer cations, and temperature.

References

[1] N. Miyamoto, M. Miyoshi, R. Kato, Y. Nakashima, H. Iwano, H. Nonaka, T. Kato, *Sci. Adv.*, **10**, eadk6452 (2024).

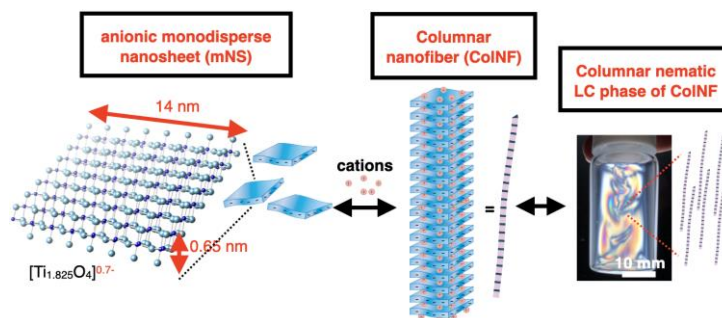


Figure 1 Schematic drawings of mNS and CoINF and crossed polarizer image of the CoINF dispersion that formed nematic LC phase.

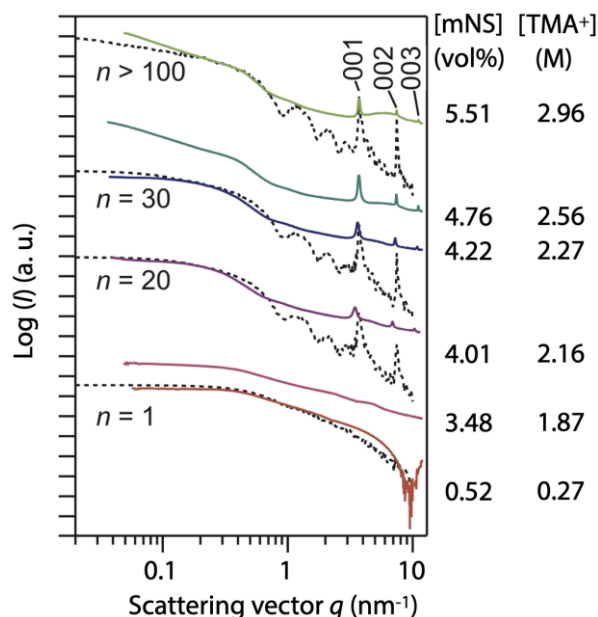


Figure 2 SAXS patterns of the aqueous mNS dispersion with varied concentrations of mNS and TMA. The dotted lines are simulated data.