Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supplementary Information (SI)

Viscoelastic properties of a thioether-based heliconical twist-bend nematogen

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These notes supplement our paper, "*Viscoelastic properties of a thioether-based heliconical twist-bend nematogen*", producing a number of additional experimental observation. These results help understating our experiments and interpretations in the main manuscript.

1 Amplitude dependent viscoelastic responses to oscillatory compressive strain

In order to see how much the elastic behavior is resistant to the oscillatory compressive strain, the amplitude dependent viscoelastic responses were investigated. As shown in Fig. S1, the loss tangent decreases as increasing the applied strain up to about 20 %, meaning that the pseudolayering elastic properties is preserved in this strain range.

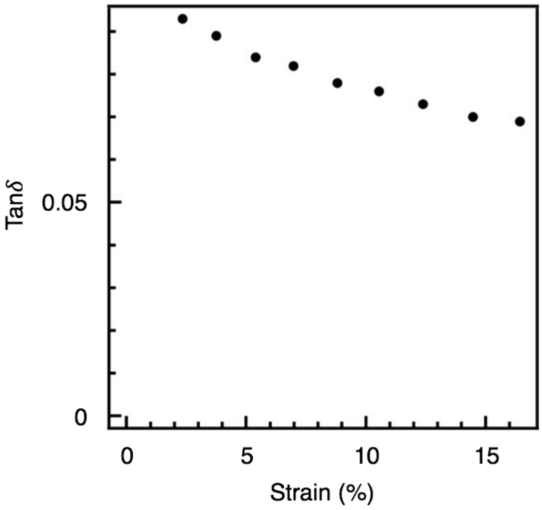

Fig. S1 Loss tangent of CBS7SCB measured in the compressive mode.

2 Fréedericksz transition measurement

In order to measure the splay constant K_{11} in the N phase, we conducted the Fréedericksz transition measurement by using a planar cell with an electric field normal to the substrates. The transmitted light through crossed polarizers is spectrally diffracted by a spectroscope (USB4000, Ocean Optics) and the light intensity at each wavelength was recorded as a function of the voltage. At the same time, the dielectric constant as a function of the voltage is also recorded by using an LCR meter (4284a, Agilent). The splay constant K_{11} is calculated from the threshold of the transmission-voltage curves (i.e., $K_{11=}$ $\varepsilon_0\Delta\varepsilon\frac{V_{th}}{\pi^2}$) as a function of temperature. Figures S2-S4 show the temperature dependence of birefringence in the N phase, the anisotropy of the dielectric constant in the N phase, and the transmission-voltage curves at different temperatures.

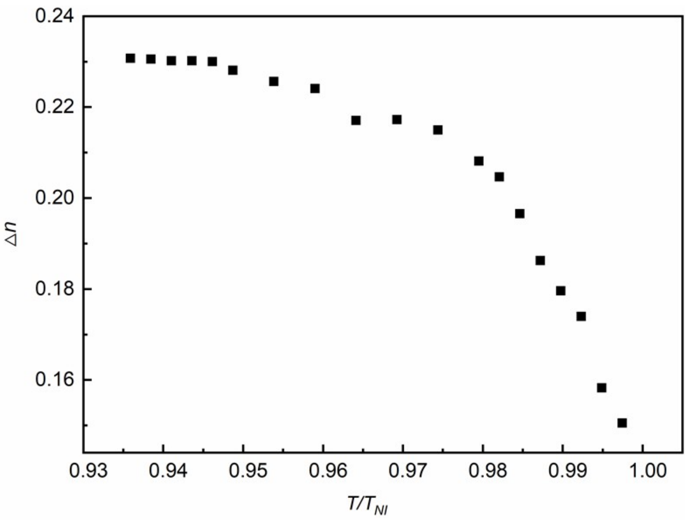

Fig. S2 Temperature dependence of the birefringence in the N phase.

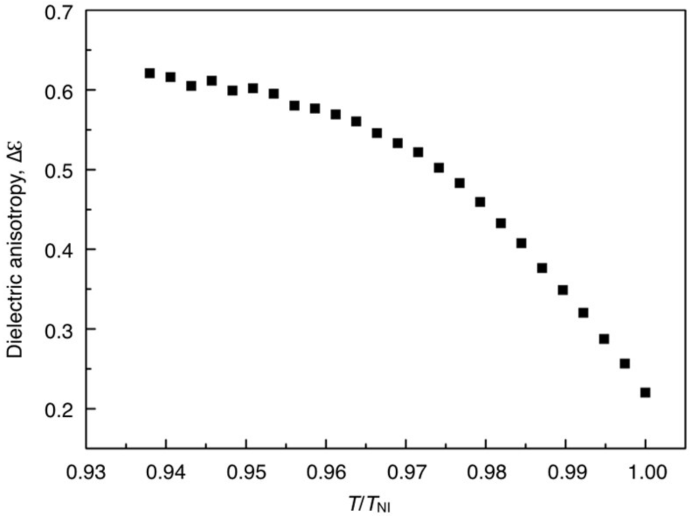

Fig. S3 Temperature dependence of the dielectric anisotropy in the N phase.

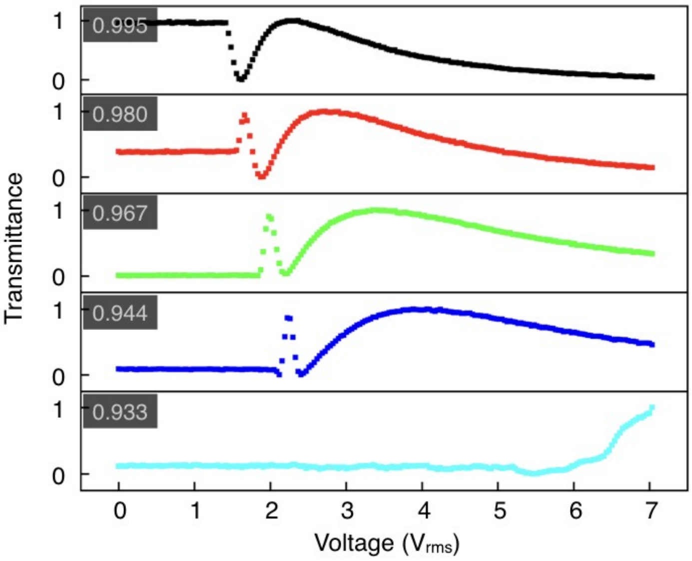

Fig. S4 Transmission-voltage curves at different temperatures (@splay geometry). The numbers located in the upper left of each column correspond to the reduced temperature, T/T_{NI}. The lowest one at T/T_{NI}=0.933 is at the temperature right below the N-N$_{\mathrm{TB}}$ phase transition.

3 Dynamic light scattering measurement

In order to supplement and double-check the precision of the measured splay constant, we conducted dynamic light scattering in the vicinity of the N$_{\mathrm{TB}}$ phase as made in Ref. [1]. It should be noted, as stated in the introduction part of the main text, the dynamic light scattering measurement in the N$_{\mathrm{TB}}$ has started to be used to study the properties of N$_{\mathrm{TB}}$ since recently and the determination of the fluctuation modes is still under debate [2-5] and out of the current scope, especially at low temperatures far away from the N-N$_{\mathrm{TB}}$ phase transition. Here, we test the time evolution of the scattered light from the sample. The input light incidences normal to the cell and its polarization is 15° (rocking angle [1]) off from the orientation of the director. The homodyne time correlation functions of the depolarized scattered intensity are calculated at each scattering angle and temperature. In this geometry, the ratio of splay and compressive moduli can be deduced from a fitting [1]. Fig. S5 shows the relaxation rate (i.e., the inverse of the relaxation time) as a function of the square of a reduced scattering vector, $\sin^2\theta$, where θ is the scattering angle, in the Iso, N and N$_{\mathrm{TB}}$ phases. By fitting the data using the eqn. (4),(6) in Ref. [1], it was estimated that the ratio of the compressive modulus B to the splay modulus K_{11} is of the order to 10^{12}-10^{13} m^{-2}. Using the measured compressive modulus of 10^4 Pa, it is calculated that $K_{11} \sim$ 1-10 nN in the vicinity of the N-N$_{\mathrm{TB}}$ phase transition. This result is well consistent with the measured one stated in the main text.

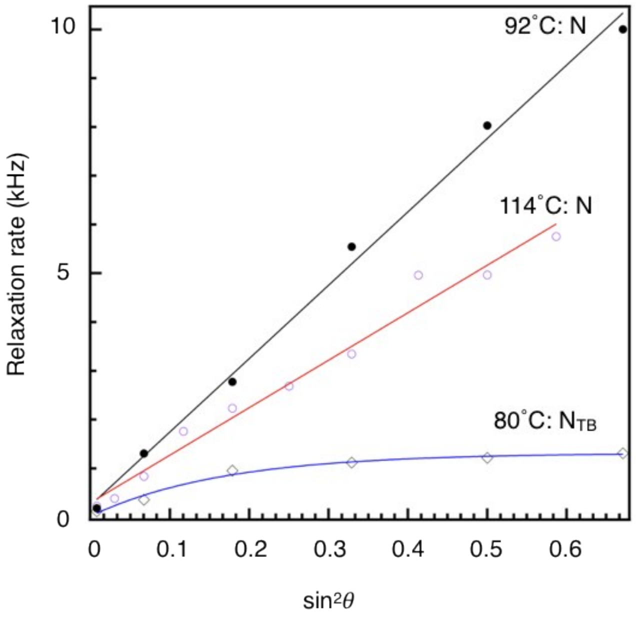

Fig. S5 Relaxation rate as a function of $\sin^2\theta$ for in the N (114 °C and 92 °C, purple open circles and black closed circles) and N$_{\mathrm{TB}}$ (80 °C, black open diamonds) phases.

4 Effective rotational viscosity

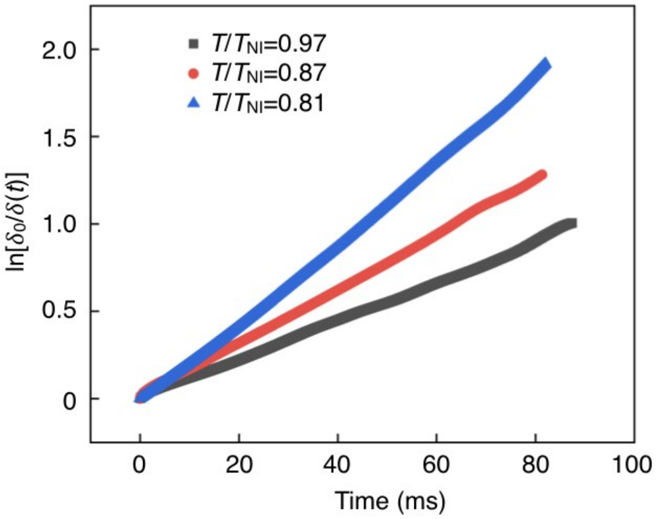

Fig. S6 Temperature dependence of the effective rotational viscosity in a log scale in both the N and the early N_{TB} phase. Variation of $ln[\delta_0/\delta(t)]$ with time at three different temperatures in the N phase., where δ_0 and $\delta(t)$ represent the total change of retardation under a voltage and the retardation at time t, respectively.

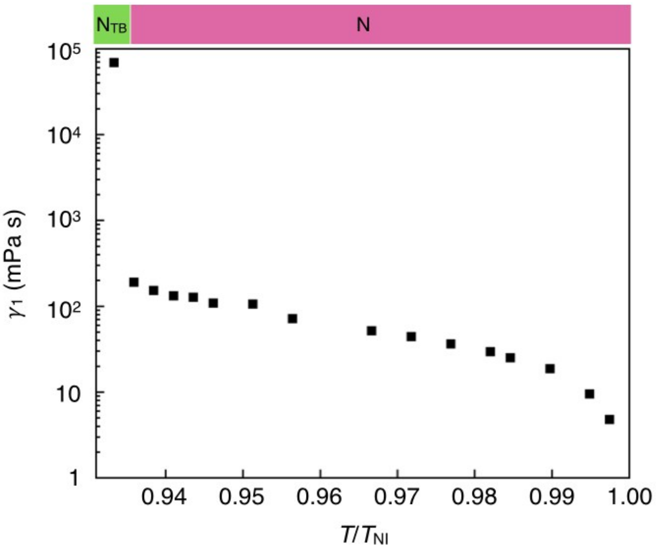

Fig. S7 Temperature dependence of the effective rotational viscosity in a log scale in both the N and the early N_{TB} phase.

References

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