Supplemental information

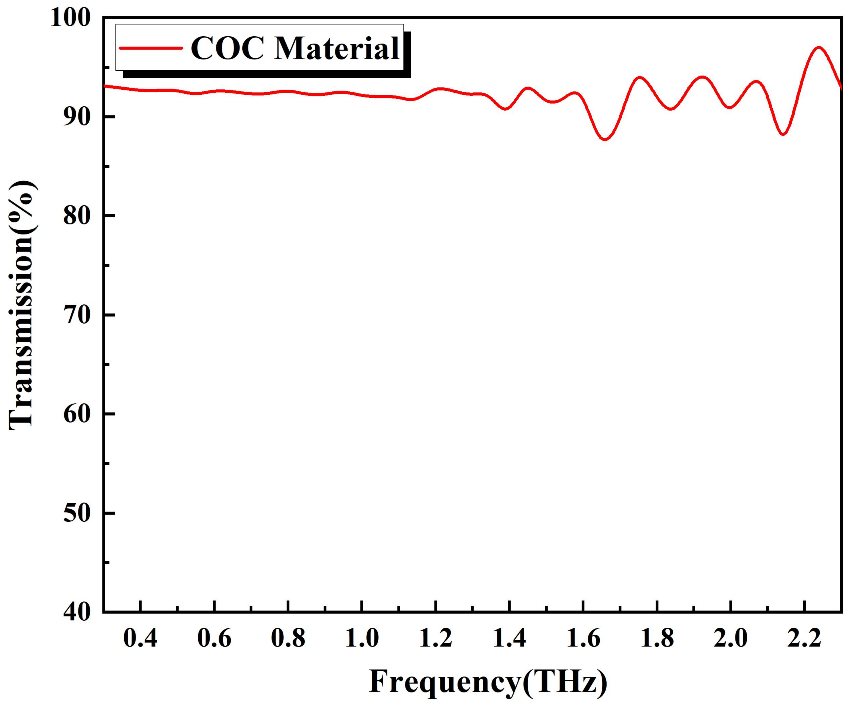

Figure S1. THz transmission spectrum of 2 mm thick COC material

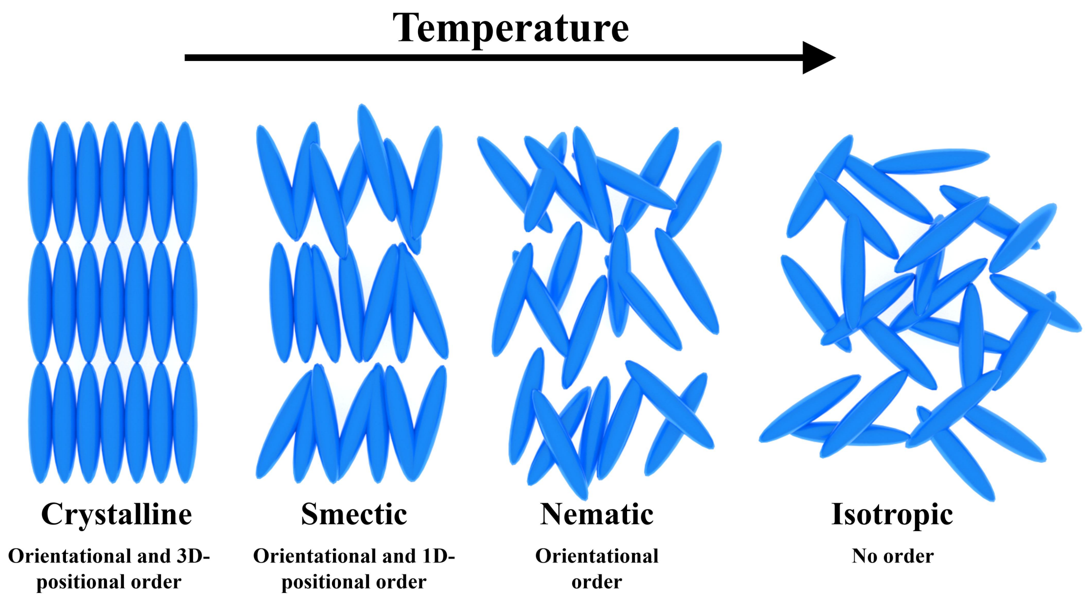

Figure S2. Schematic diagram of phase sequence and structure of thermotropic molecules. When heated, the 3D structure partially crystallizes in an ordered manner and forms a low dimensional smectic phase, and then evolves into a nematic phase with pure orientation and order. Finally, at higher temperatures, the formation of normal isotropic liquids is observed.

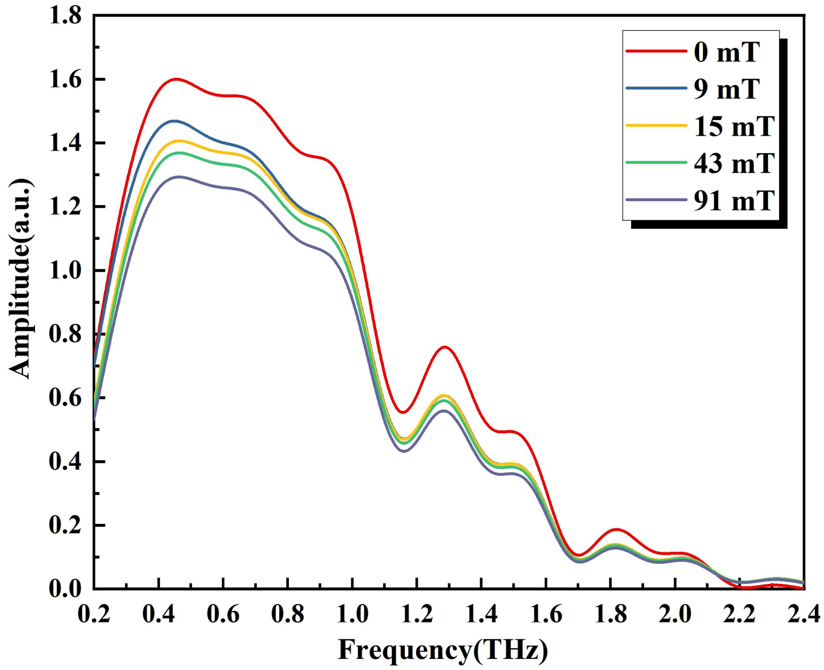

Figure S3. THz frequency domain spectrum of a magnetic fluid at different magnetic field strength.

Calculation methods

In this experiment, the thickness of the sample detection area of the THz microfluidic chip had hundred-micron level. To eliminate the influence of Fabry–Perot oscillation on the experiment, we used the flat-plate medium model based on the Fresnel formula proposed by Dorney [30] to process the experimental data. In the model, the calculation formulas of sample refractive index n(ω), extinction coefficient k(ω), and absorption coefficient α(ω) are as follows:

$$n(\omega) = \frac{\varphi(\omega)}{\omega d} + 1,$$

$$\alpha(\omega) = \frac{2k(\omega)\omega}{c} = \frac{2}{d} ln \frac{4n(\omega)}{A(\omega)[n(\omega) + 1]^2}$$

where c denotes the speed of light, d denotes the sample thickness, ω denotes the signal angular frequency, A(ω) denotes the ratio of the Fourier transform frequency-domain spectral amplitude of the sample signal and the reference signal, and φ(ω) denotes the phase difference between the sample signal and the reference signal. The relationship between the refractive index, extinction coefficient, and dielectric constant ε, conductivity σ is as follows:

$$\varepsilon = \varepsilon_r + i\varepsilon_i,\ \varepsilon_r = n^2 - k^2,\ \varepsilon_i = 2nk,$$

$$\sigma = \sigma_r + i\sigma_i,\ \sigma_r = \varepsilon_0 \omega \varepsilon_i,\ \sigma_i = \varepsilon_0 \omega (1 - \varepsilon_r)$$

To evaluate the efficiency of the modulation process, we define the MD as follows:

$$MD = \frac{E_0(\omega)^2 - E_t(\omega)^2}{E_0(\omega)^2} \times 100\%$$

where $E_t(\omega)$ and $E_0(\omega)$ denote the amplitude intensities of the modulated and unmodulated fields, respectively.