Electronic Supplementary Information

Strain-enhanced Sensitivity of Polymeric Sensors Templated from Cholesteric Liquid Crystals

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Supporting Video S1: The sample shown in this video is strained extracted polymeric film films synthesized from 20% RM257, 7.5% chiral dopant and balance E7. This video is composed of reflection mode polarized micrographs taken during toluene sensor test. Scale bar: 200μm

Calculation of strain introduced by wedge cell

We first calculated the change of the film thickness (Δh) starting from equating the thickness of the film at disclination line and found as;

$$\Delta h_i = \frac{p}{2} \times \left[\frac{m_i}{m_{i+1} + m_i}\right] \qquad \text{Eqn. S1}$$

where an integral number m of half pitches of length p/2 be fitted into sample thickness h[1].

Then, we calculated radius of disclination line (r_d) using a model based on elastic energy proposed by Feldman et al[1]. In this model, only twist part of elastic energy was used and the location of disclination lines were calculated as;

$$r_d = \sqrt{2R \times \left(m \times \frac{p}{2} + \Delta h\right)} \qquad \text{Eqn. S2}$$

where R is the radius of curvature of plano-convex (PCX) lens.

We also calculated the amount of strain introduced to the CLC film in a wedge cell before polymerization for compressed and stretched parts in the two sides of disclination line, as;

$$strain = -\frac{\Delta h}{m \times \frac{p}{2}} \;\; for\ compressed\ part \qquad \text{Eqn. S3}$$

$$strain = \frac{\Delta h}{m \times \frac{p}{2}} \;\; for\ stretched\ part \qquad \text{Eqn. S4}$$

Calculation of strain by extraction

Strain values we calculated using Eqn. S3 and S4 was for CLC film in wedge cell before polymerization. However, as we used extracted films in our sensor tests, we needed to calculate the amount of strain introduced via extraction.

We recorded UV-visible spectra of the films with 5-25% chiral dopant and showed peak wavelengths at the reflected light in Fig. 2a. We observed that the peak wavelength and chiral dopant ratio have a linear relationship. Moreover, at low chiral concentrations, no wavelength peak was observed in the visible region before polymerization. Therefore, in order to calculate the shrinkage via extraction, we extrapolated the before polymerization data and estimated the wavelength peak of CLCs at low chiral concentrations before polymerization (Fig. S1). At 7.5% chiral dopant concentration, we observed 45% of wavelength shift which can be considered as the strain in compression mode introduced via extraction; therefore, all the regions became compressed. By considering the strain introduced via both extraction and wedge cell, we re-calculated the strain values and mentioned the parts of the film as high-compressed, medium-compressed and low-compressed in the main text.

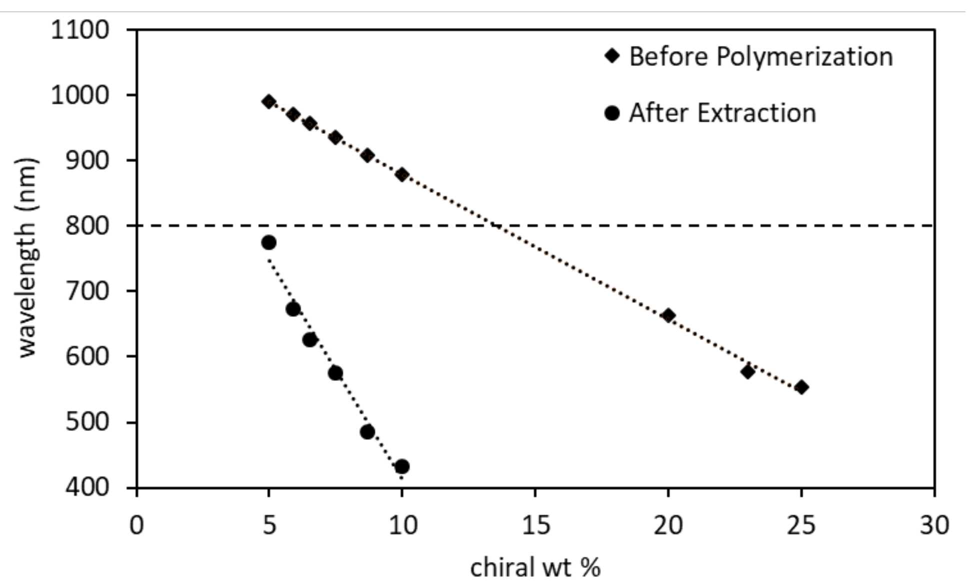

Fig. S1. UV-visible spectrum wavelength of CLCs before polymerization and after extraction

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Reflection mode polarized micrographs of CLC-templated polymeric films synthesized from 20% RM257, 7.5% chiral dopant and balance E7 upon 0 to 30000 ppm toluene exposure were collected at steady state and shown in Fig. S2.

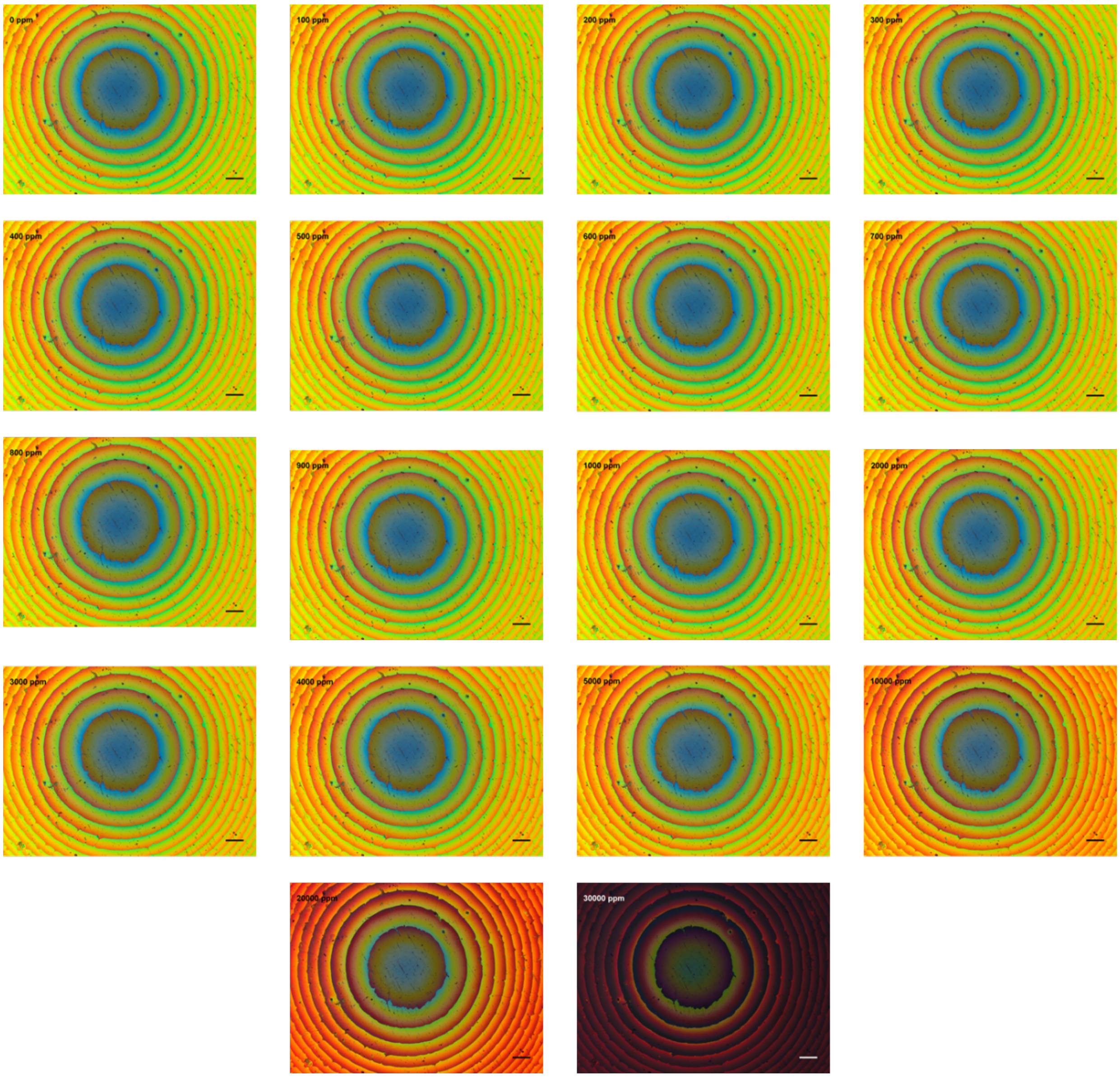

Fig. S2. Reflection mode polarized optical micrographs of CLC-templated polymeric films synthesized from 20% RM257, 7.5% chiral dopant and balance E7 upon 0 to 30000 ppm toluene exposure. (scale bar: 200 µm)

References

1 L. M. Feldman, A. I., Crooker and P. P., Goh, *Phys. Rev. A*, 1987, **35**, 842–846.