

## **Electronic Supplementary Information**

# **Circular Dichroism based Refractive Index Sensing using Chiral Metamaterials**

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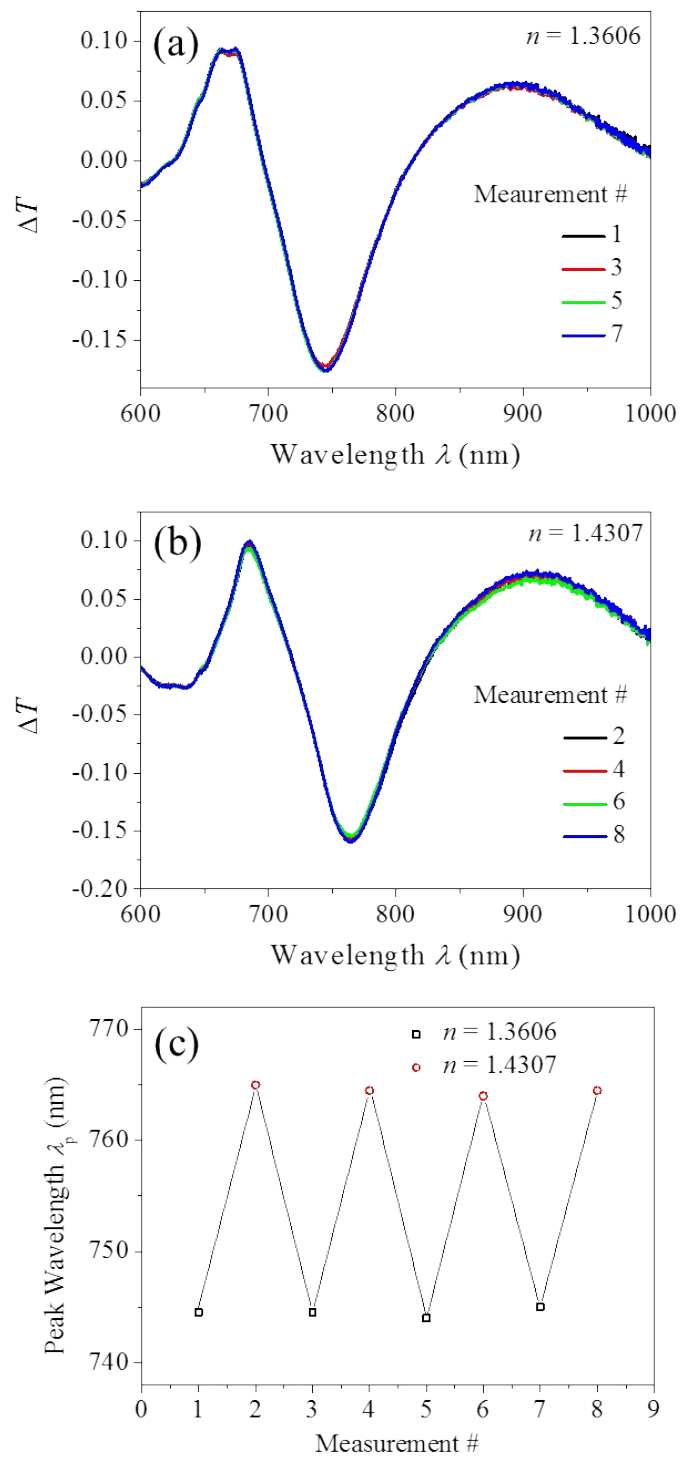
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## S1. FDTD simulation

Three-dimensional FDTD simulations were performed using a commercial software package, XFDTD 7.3. The geometric models of Au fan-shaped nanostructures are shown in Figure 2 in main text. The fan-shaped nanostructures were assumed to be uniformly coated on nanospheres with a thickness of 100 nm. A mesh size of 4 nm was used in the FDTD simulations. The time step was  $5.38818 \times 10^{-18}$  s. A modified Debye model  $\varepsilon(\omega) = \varepsilon_{\infty} + \frac{\varepsilon_s - \varepsilon_{\infty}}{1 + i\omega\tau} + \frac{\sigma}{i\omega\varepsilon_0}$  was used for the permittivity of Au, where  $\omega$  is the angular frequency,  $\varepsilon_0$  is the vacuum permittivity,  $\varepsilon_{\infty} = 11.575$ ,  $\varepsilon_s = -15789$ ,  $\tau = 8.71 \times 10^{-15}$  s, and  $\sigma = 1.6062 \times 10^7$  S/m.<sup>1</sup> Polystyrene bead was assumed to be non-dispersive dielectric material with  $\varepsilon = 2.5122$ .

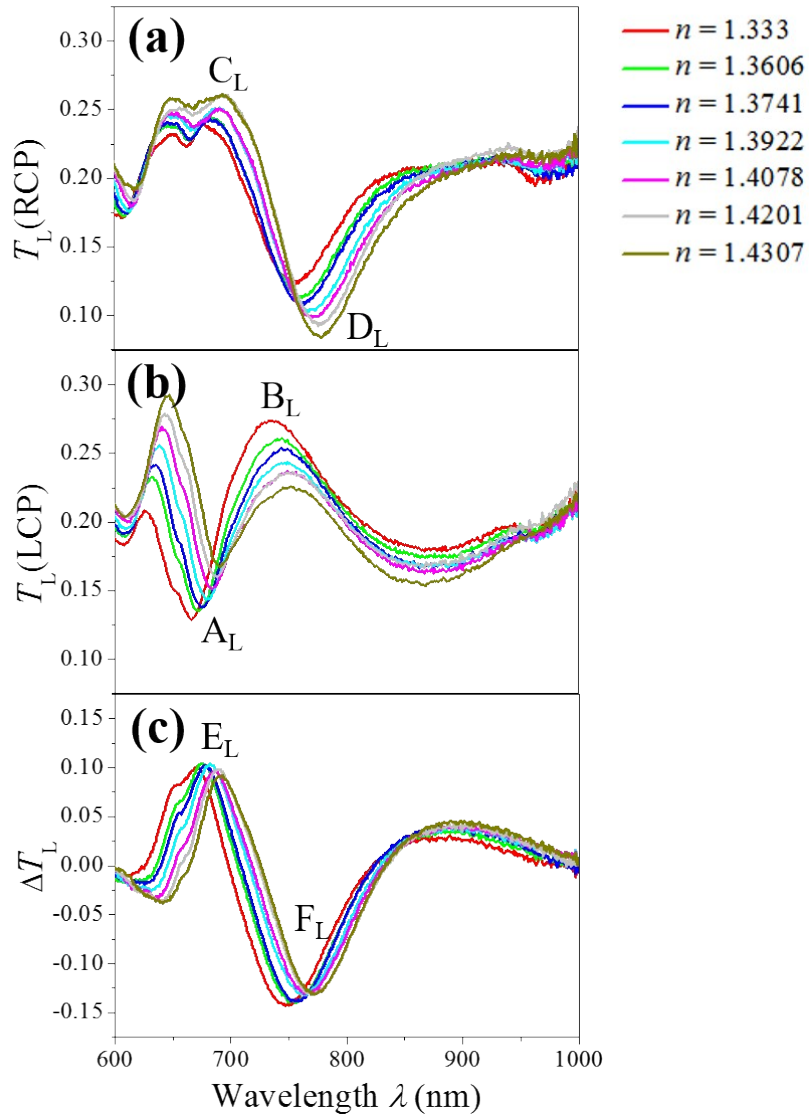
## **S2. Examination of the rinsing method**

In the sensing experiment, only one substrate was used for the measurements in different sucrose solutions. When changing solutions, the substrate was rinsed with the sucrose solution at the next concentration. But it is possible that the previous sucrose solution was not completely removed after rinsing, which could change the concentrations of sucrose solutions in the following measurements. Re-measuring the previous solution is a good way to ensure the concentration of the measured sucrose solution is correct. Therefore, we performed an experiment in which two concentrations of sucrose solutions ( $n = 1.3606$  and  $1.4307$ ) were selected and measured alternately using one substrate (measurement #1–8). The measured  $\Delta T$  spectra are shown in Figure S1a and S1b. It is observed that the spectra measured at the same concentration are almost identical. The wavelengths of the negative peaks around 750 nm are shown in Figure S1c. For each refractive index, the variation of the peak wavelength is less than 1 nm, which indicates that the refractive indices in different measurements are the same. This can serve as a control experiment to demonstrate that the concentrations of sucrose solutions are correct and not influenced by previous solutions.



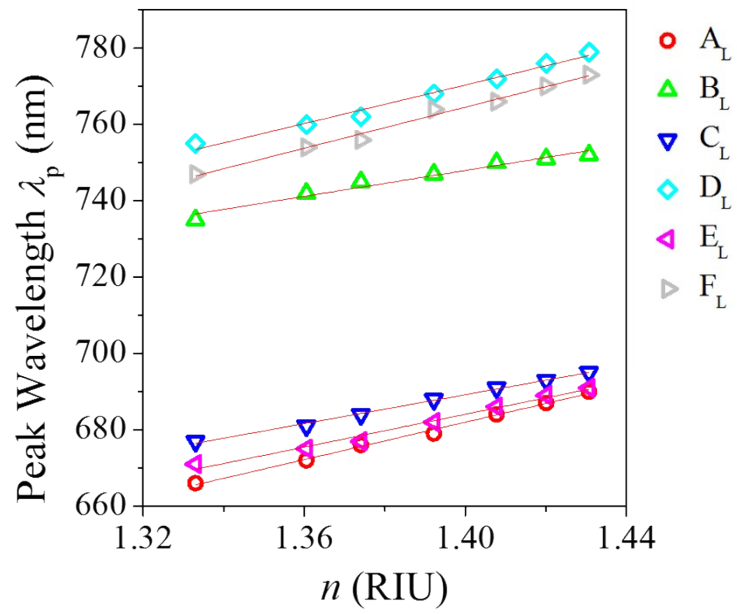
**Figure S1.**  $\Delta T$  spectra of Au fan-shaped nanostructure in sucrose solutions with (a)  $n = 1.3606$  and (b)  $n = 1.4307$ . (c) Peak wavelengths of the negative peak located around  $\lambda = 750$  nm in different measurements.

**S3.  $T(\text{RCP})$ ,  $T(\text{LCP})$  and  $\Delta T$  spectra of Structure L in sucrose solutions at different concentrations**



**Figure S2.** (a)  $T_L(\text{RCP})$ , (b)  $T_L(\text{LCP})$ , and (c)  $\Delta T_L$  spectra of Structure L in different sucrose solutions.

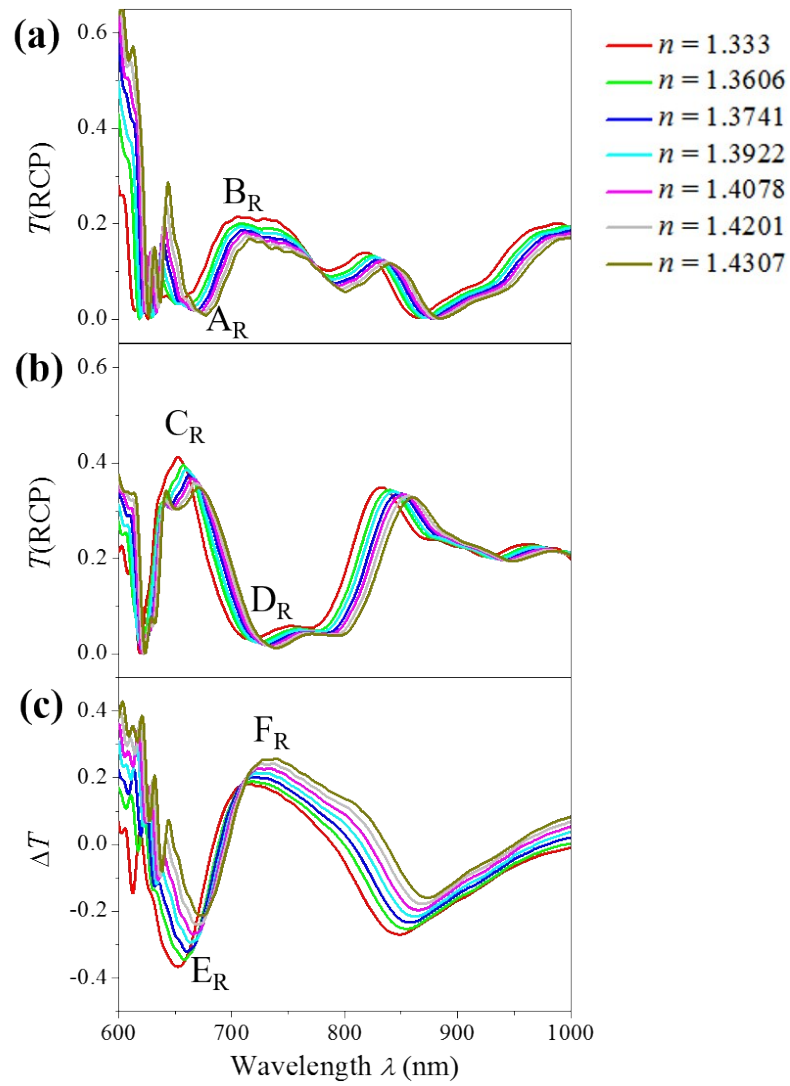
#### S4. $\lambda_p$ versus $n$ for Structure L



**Figure S3.** Peak wavelength  $\lambda_p$  versus refractive index  $n$  of sucrose solutions for Structure L.

The straight lines are linear fittings.

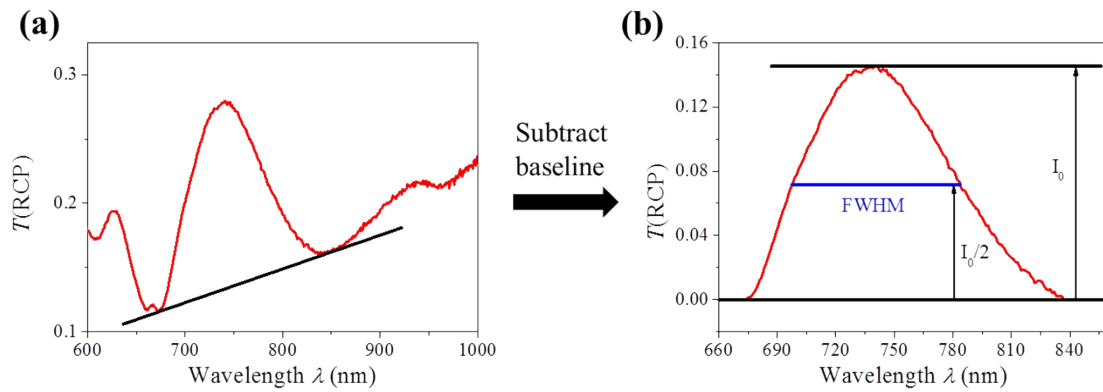
**S5. Simulated  $T_R(\text{RCP})$ ,  $T_R(\text{LCP})$ , and  $\Delta T_R$  spectra for Structure R**



**Figure S4.** Simulated (a)  $T_R(\text{RCP})$ , (b)  $T_R(\text{LCP})$ , and (c)  $\Delta T_R$  spectra of Structure R in media with different  $n$ .

## S6. Determination of FWHM

The determination of FWHM of  $T(\text{RCP})$ ,  $T(\text{LCP})$  and  $\Delta T$  peaks follows the same procedure. First, a straight baseline that connects the two minimums (maximums for negative peaks) is created, as shown in Figure S5a. Then after subtraction from the original data by the baseline, a new peak is obtained. This new peak is used to find FWHM as illustrated in Figure S5b.



**Figure S5.** (a) Creating a straight baseline. (b) Obtaining FWHM after subtracting the baseline.

## REFERENCE

- <sup>1</sup> H. F. Gai, J. Wang, and Q. Tian, Appl. Opt. **46** (12), 2229-2233 (2007).