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Supporting Information

Humidity-gated Temperature-Responsive Photonic Infrared Reflective Broadband Coatings

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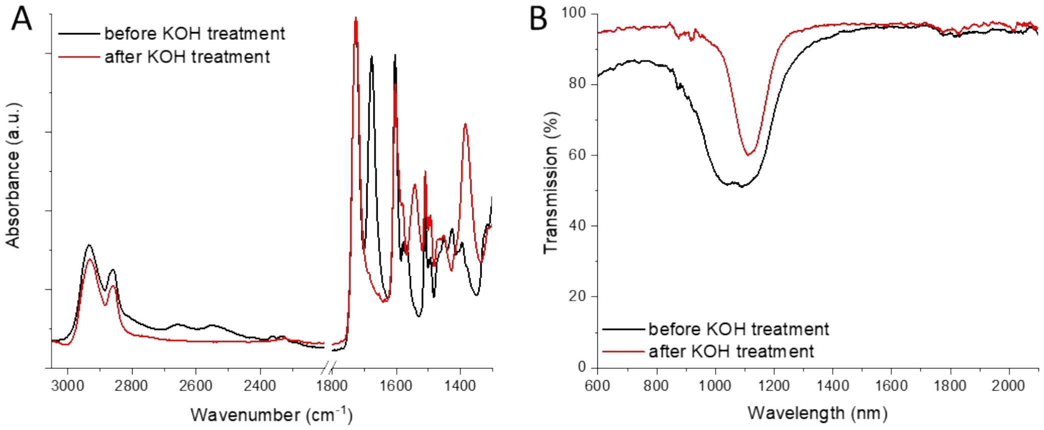

Figure S1: A) FTIR absorbance spectra of the Ch-LC coating before and after alkaline treatment and subsequent drying, showing disruption of the hydrogen bonds. B) Transmission spectra of the Ch-LC coating before and after the alkaline treatment, measured by UV-Vis. The resulting cholesteric reflection band of the coating has a band broadness of 120 nm, measured by full-width half-length.

In the initial non-activated coating, broad signals between 2700 and 2450 cm^{-1} and a strong signal at 1680 cm^{-1}, related to the OH-stretching vibration of the hydrogen bonds, are present. After the alkaline treatment, these signals are replaced by two others at 1547 cm^{-1} and 1388 cm^{-1}, arising from the symmetric and antisymmetric stretching of the carboxylate salts, respectively, showing the disruption of the hydrogen bonds in the coating (Figure S1A). Moreover, due to the covalently crosslinked network in the coating caused by the diacrylic monomers **2** and **3**, the cholesteric order was maintained after the alkaline treatment (Figure S1B). Some narrowing and loss in the intensity of the reflection band was observed. However, this slight decline in molecular order is similar to previously reported data for optical humidity sensors based on hydrogen-bonded Ch-LC polymers.[S1,2]

$$t_d = \frac{B * \left(\ln\left(\frac{RH}{100}\right) + \frac{A * t}{B + t}\right)}{A - \ln\left(\frac{RH}{100}\right) - \frac{A * t}{B + t}}$$

Equation S1: The extended Magnus equation is used for the relationship between the dewpoint and the relative humidity and temperature. The t_d is the temperature of the dewpoint (°C), A and B are coefficients, RH is the relative humidity (%) and t is the temperature (°C).[S3] The coefficients are obtained from literature, A = 17.625 and B = 243.04 °C.[S4]

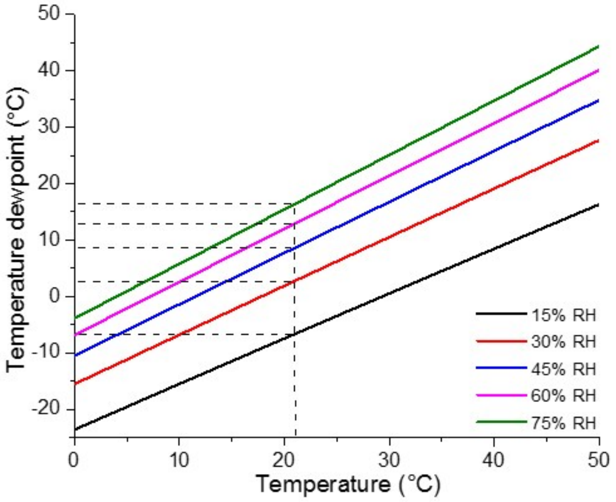

Figure S2: Relationship between the temperature of the environment and the dewpoint at various RH. The calculations are based on equation S1. The dashed lines shown are guidelines for the dew points at various RH at an environmental temperature of 21°C.

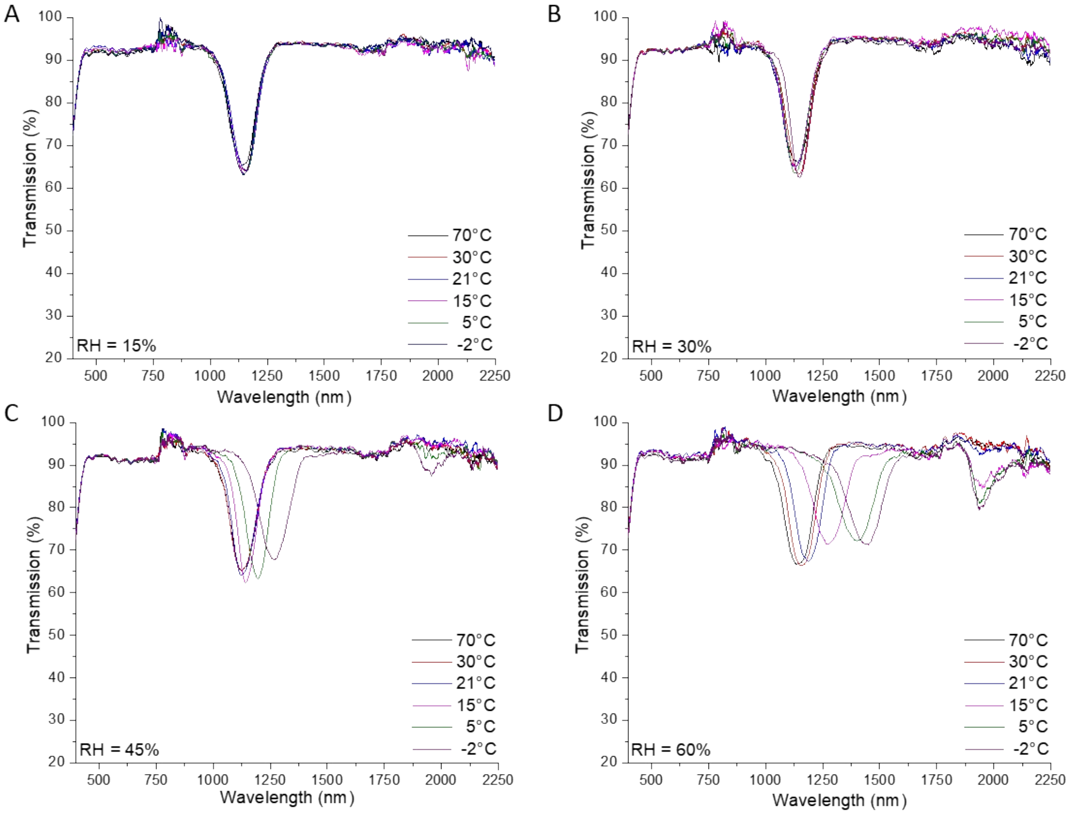

Figure S3: Transmission spectra of the Ch-LC polymer salt coating prepared from Ch-LC mixture I. Spectra were taken at various temperatures at a RH of (A) 15%, (B) 30%, (C) 45% and (D) 60%.

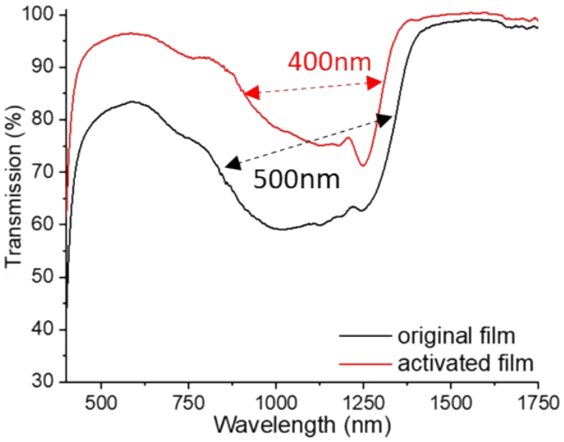

Figure S4: Transmission spectra of the Ch-LC coating prepared from Ch-LC mixture II. Before the alkaline treatment the coating had a bandwidth of approximately 500 nm. The activated hygroscopic polymer salt coating has a band broadness of approximately 400 nm. Bandwidths are measured by full-width half-length as is indicated by the dashed lines.

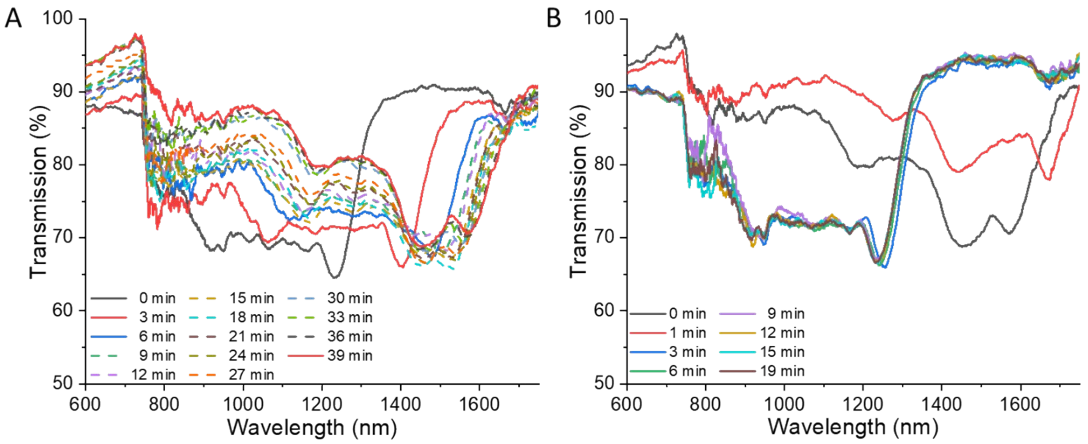

Figure S5: Transmission spectra of the time-dependent studies at 75% RH showing a) the responsive behavior of the coating after the coating was cooled 50°C/min from 70°C to 5°C and B) the responsive behavior of the Ch-LC reflection band after the coating was heated 50°C/min from 5°C to 70°C. Spectra were measured every 3 minutes with t = 0 at the start of the cooling or heating ramp.

References

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