Supplementary information for Development of 4D Printed Smart Fresnel Lenses: Dynamic Photochromic and UV-Blocking Capabilities via Vat Photopolymerization

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Supplementary Material Note 1: Lens design based on constant width

The Fresnel lens design has two main configurations: constant height and constant width. The supplementary information in Figure S1 includes the diagram of the constant width configuration of the Fresnel lenses and illustrates the mathematical concepts involved in the design. In this context, the width of each ring (Δ**w**) is determined using Equation S1, given below:

$$\Delta \mathrm{w} = \left({}^{d_r}/_{2}\right)/\mathrm{m} \tag{S1}$$

Where d_r is the diameter of the lens and m is the number of annular rings that make up the Fresnel lens. The height (h_i) depends on both Δw and the angular deflection (β_i) of each ring, calculated using Equation S2:

$$h_i = \Delta \mathrm{w} \times \tan \beta_i \tag{S2}$$

The angular deflection is a function of the radius of the ith ring (r_i), the focal length (f) and the refractive index (n) of the material, as illustrated in the following Equation S3:

$$tan\, \beta_i = r_i / n\sqrt{r_i + f^2} - f \tag{S3}$$

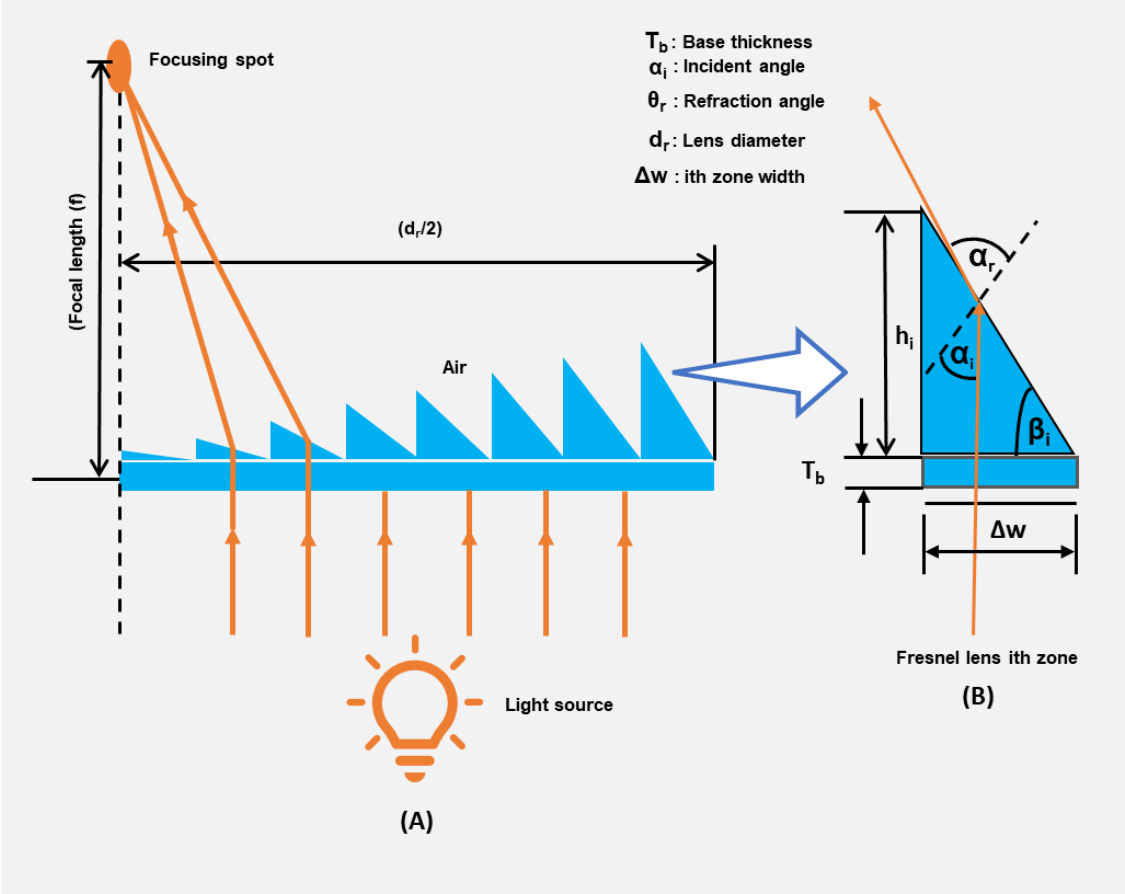

Figure S1: (A) Schematic representation of Fresnel lens and (B) ith zone element.

Supplementary Material Note 2: Color difference measurements

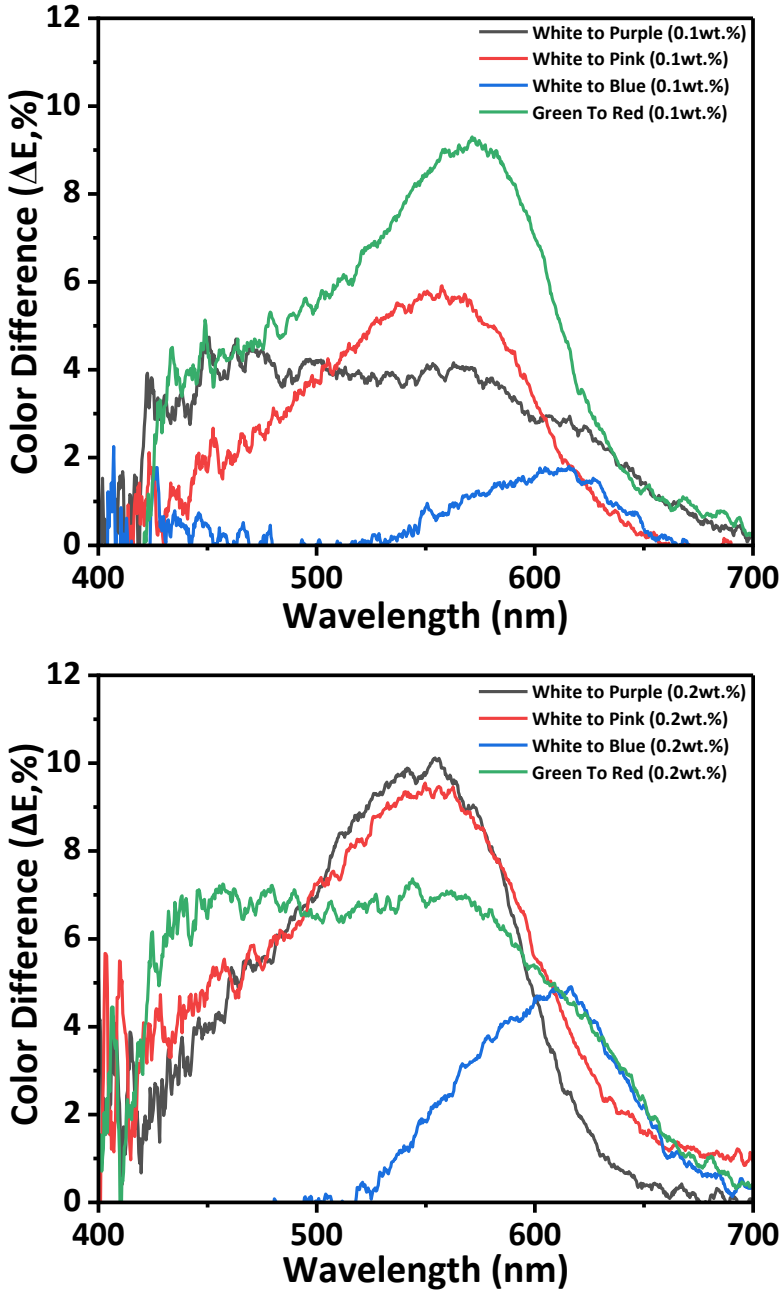

Figure S2: Color difference measurements for the lenses in the 0.1 to 0.2 wt.% concentration range measured as the difference in transmission spectra of respective lenses with and without UV light exposure.