

## **Electronic Supplementary Information**

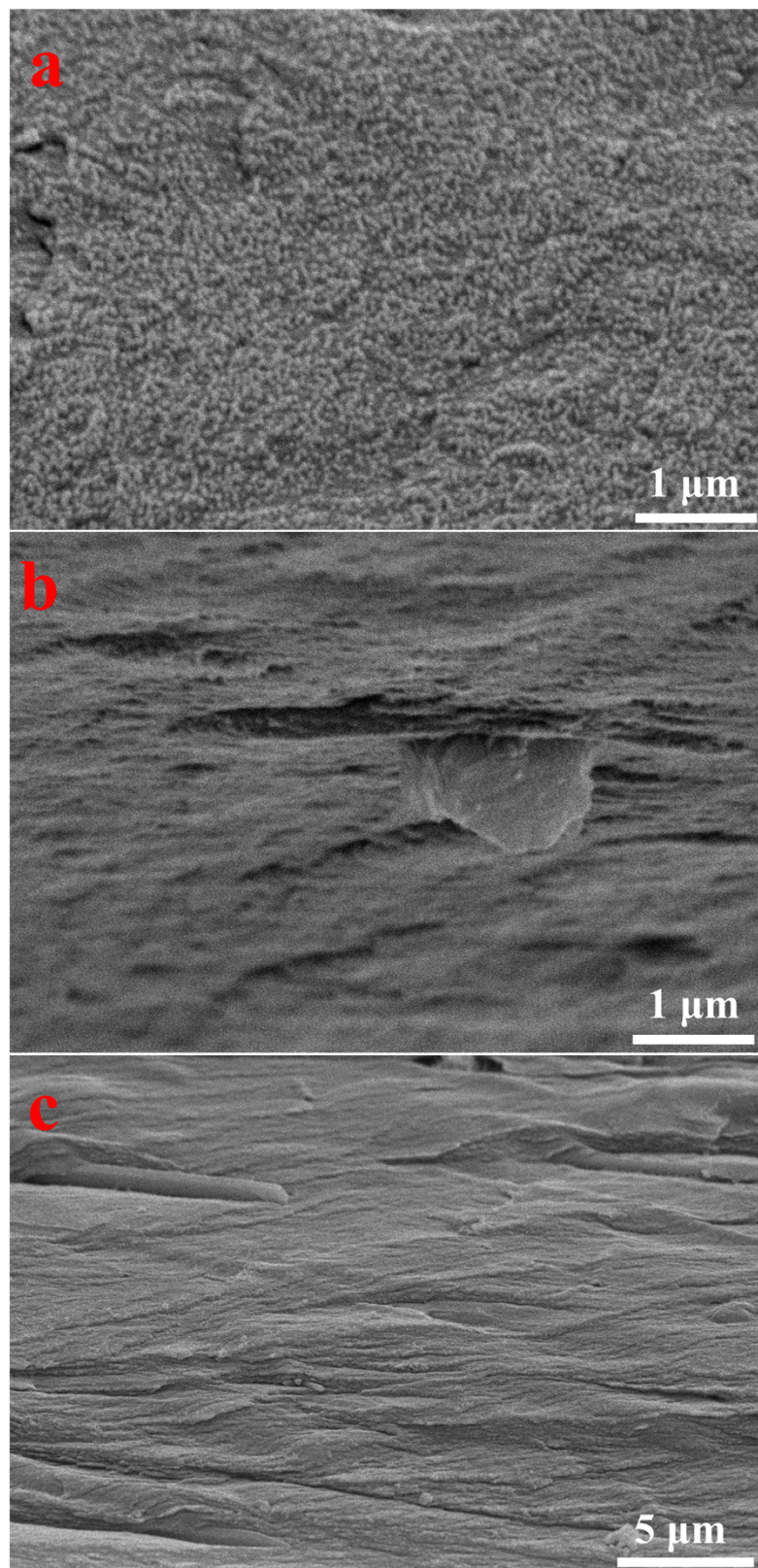
### **Transparent nanocellulose hybrid films functionalized with ZnO nanostructures for UV-blocking**

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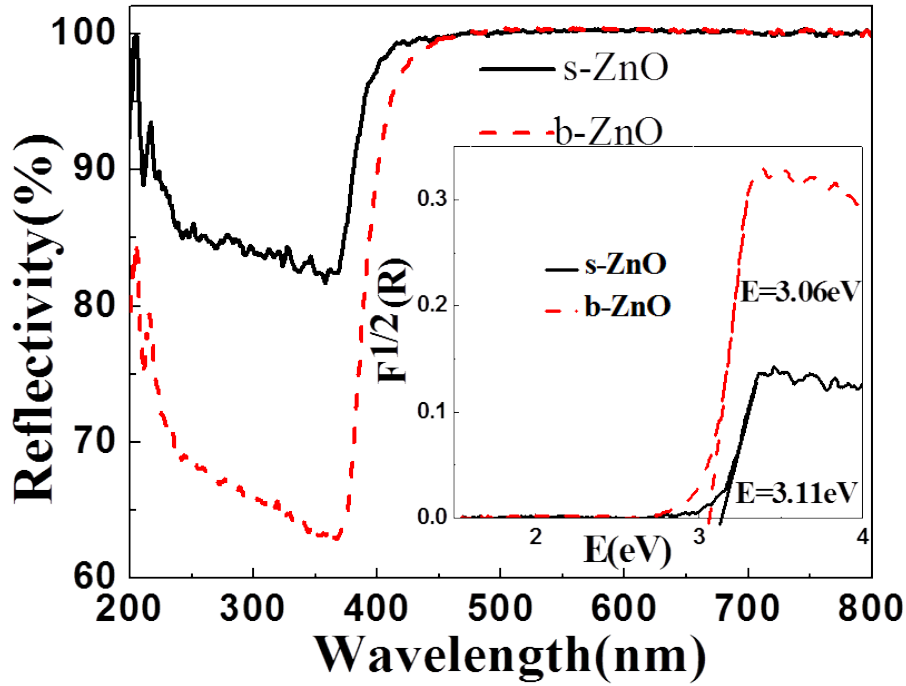
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**Figure S1.** SEM images of the cross-section of NC film (a), NC/s-ZnO<sub>4</sub> (b) and NC/b-ZnO<sub>4</sub> hybrid film (c).

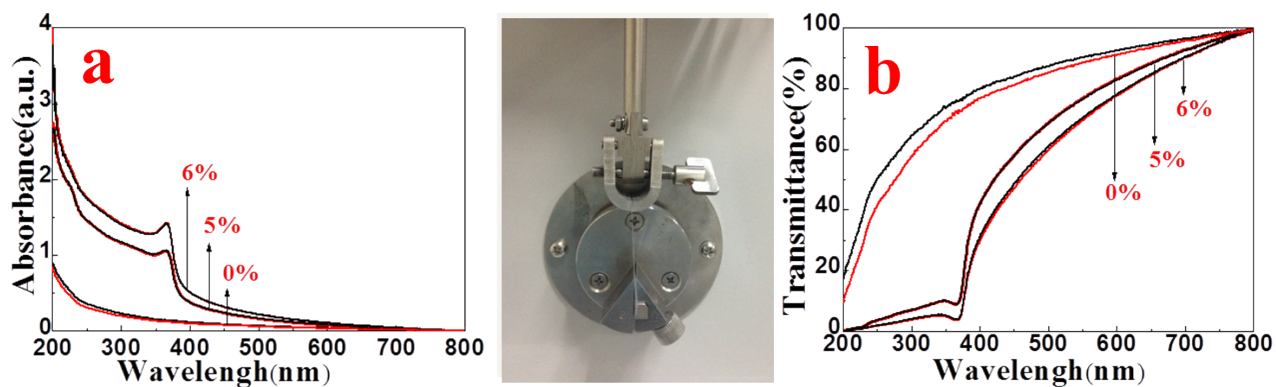


**Figure S2.** The solid diffuse reflection UV-vis spectra of s-ZnO (solid line) and b-ZnO (dash line).

Solid diffuse reflection UV-vis spectra were measured in air at the wavelength range of 200~800 nm. The reflectance data was converted to the absorption coefficient  $F(R)$  values according to the Kubelka-Munk radiative transfer model, as reflected in Figure S2. The band gap energy ( $E_g$ ) of the samples was obtained according to the following equation (1):

$$F(R) = (1-R)^2/2R \quad (1)$$

Here,  $R$  is fractional reflectance,  $F(R)$  is the absorption coefficient. The  $E_g$  values were determined as 3.06 and 3.11 eV for s-ZnO and b-ZnO by making the tangential line of the  $F1/2(R)$ - $E_g$  curve to inset with the horizontal axis, respectively. The s-ZnO reflectance blue-shifted about 50 meV compared to b-ZnO as shown in the onset of Figure S2. The solid diffuse reflection UV-vis results showed that the obtained ZnO owned a much higher reflectivity than the previous prepared ZnO.<sup>S1,S2</sup> For an interesting finding was that the s-ZnO possessed a better UV reflection compared to the b-ZnO, which corresponded to the evidence of NC/s-ZnO hybrid films had a higher UV-blocking Ratio.



**Figure S3.** UV-vis spectra of NC/s-ZnO (a, b) hybrid films before (Black curves) and after bending for 200 times (Red curves).

**Table S1.** Photo-degradation results of NC/s-ZnO hybrid films under UV irradiation.

	Before UV irradiated (g)	UV irradiated for 24 h (g)	UV irradiated for 48 h (g)	UV irradiated for 72 h (g)
NC/ZnO0	0.0334	0.0333	0.0331	0.0330
NC/s-ZnO1	0.0354	0.0351	0.0350	0.0351
NC/s-ZnO2	0.0347	0.0343	0.0344	0.0344
NC/b-ZnO1	0.0333	0.0333	0.0332	0.0330
NC/b-ZnO2	0.0338	0.0335	0.0336	0.0334

S1 P. Dolcet, F. Latini, M. Casarin, et al., Eur. J. Inorg. Chem., 2013, **13**, 2291.

S2 R. Dharmadasa, A. A. Tahir, K. G. U. Wijayantha, et al., J. Am. Ceram. Soc., 2011, **94**, 3540