polymers

MDPI

Supplementary Materials

Supplementary Methods:

Note S1. Surface Free Energy Calculation

On the basis of Yong's equation, the surface free energies of BF samples were calculated, as shown in Equation 1:

$$\gamma_S = \gamma_L \cos\theta + \gamma_{SL}, \quad (1)$$

where γ_S, γ_L, and γ_{SL} represent the surface tension of the solid, liquid, and solid–liquid interfaces, respectively. θ represents the initial contact angle between the solid (S) and the liquid (L) interfaces.

The OWRK method was used to determine the value of γ_S, as presented in Equation 2:

$$\gamma_L(1 + \cos\theta) = 2\sqrt{\gamma_S^d \gamma_L^d} + 2\sqrt{\gamma_S^p \gamma_L^p}, \quad (2)$$

where γ_S^d and γ_L^d represent the dispersion components on the surface of the solid and liquid interfaces, respectively. γ_S^p and γ_L^p denote the polar components on the surface of the solid and liquid interfaces, respectively.

By combining Equations (1) and (2), Equation (3) is obtained:

$$\frac{\gamma_L(1 + \cos\theta)}{2\sqrt{\gamma_L^d}} = \sqrt{\frac{\gamma_L^p}{\gamma_L^d}} \times \sqrt{\gamma_S^p} + \sqrt{\gamma_S^d}, \quad (3)$$

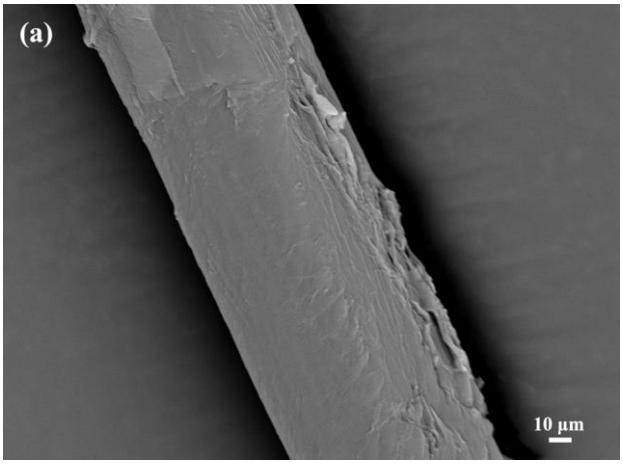
Therefore, two different liquids, namely deionized water (polar) and diiodomethane (non-polar), were tested in this study to obtain the value of θ. In addition, the surface tension and components of the aforementioned liquids (*i.e.* γ_L, γ_L^d and γ_L^p) can be found in Table 2. According to Equation (3) and the graphing method, if $\sqrt{\frac{\gamma_L^p}{\gamma_L^d}}$ is defined as independent variable (x) and $\frac{\gamma_L(1 + \cos\theta)}{2\sqrt{\gamma_L^d}}$ is defined as (y), a linear relationship is established as shown in Equation 4：

$$y = \sqrt{\gamma_S^p} \cdot x + \sqrt{\gamma_S^d}, \quad (4)$$

allowing the slope and intercept of the line to be used to calculate γ_S^p and γ_S^d. Consequently, the solid surface free energy γ_S can be obtained by Equation 5:

$$\gamma_s = \gamma_S^p + \gamma_S^d, \quad (5)$$

Supplementary Figures and Tables:



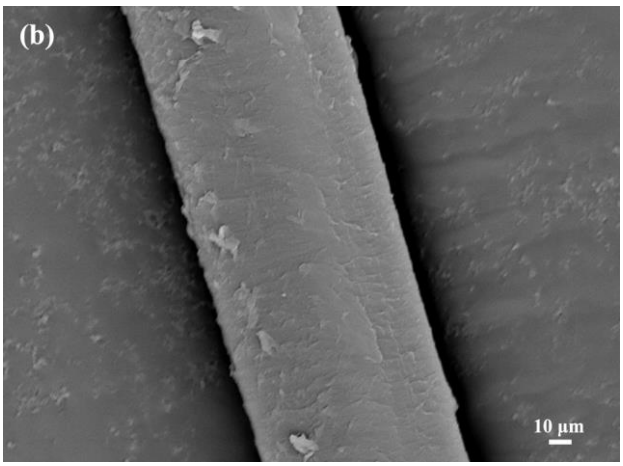


Figure S1. SEM observations of (a) C-BFs and (b) PDA/ODA-BFs

The relatively smooth surface is apparent in the C-BFs sample, which is in accordance with the typical characteristics of natural bamboo fibers (Figure S1a). After coating with polydopamine (PDA) in a mildly conditions just like marine environment, a much rougher film composed of PDA/ODA coating was observed on the fiber surface (Figure S1b). It was reported that the traditional modified method with harsh reaction environment, including hot air and strong alkaline solution, can destroyed the natural structures and components of lignocellulose fibers through decomposing or removing the hemicelluloses and lignin, leaving many small holes and crevices on the surface [1,2]. As expected, after the mussel-inspired surface modification pathway, the distinct structure and components of BF were retained, because the whole process of PDA decoration was conducted under mail conditions, avoiding causing the aforementioned damages.

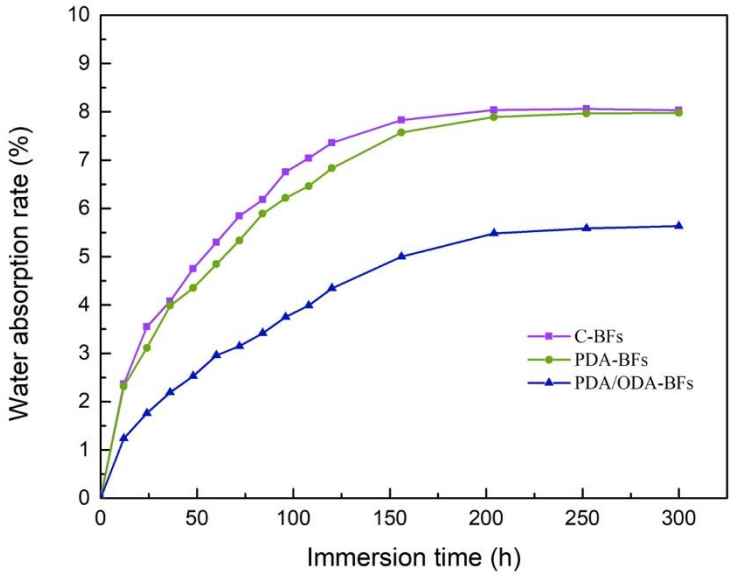


Figure S2. Effects of fiber surface modification on water absorption of the composites.

Table S1. The calculated water diffusion parameters of BFs/PBS composites

Label	n	k ($h^{-1/2}$)	R^2	M_e[1] (%)	$D^2 \times 10^{-13}$ (m^2/s)
C-BFs	0.4743	0.0942	0.9943	8.03±0.58	1.20
PDA-BFs	0.4745	0.0885	0.9971	7.97±0.42	1.08
PDA/ODA-BFs	0.5397	0.0566	0.9982	5.63±0.14	0.79

[1] M_e represents the equilibrium moisture content of the composites; [2] D represents the diffusion coefficient.

References

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2. Cheng, H.T.; Gao, J.; Wang, G.; Shi, S.Q.; Zhang, S.B.; Cai, L.P. Enhancement of mechanical properties of composites made of calcium carbonate modified bamboo fibers and polypropylene. *Holzforschung* 2015, 69, 215-221.

Article Information

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