Electronic Supplementary Material (ESI) for RSC Advances.

Bio-inspired Natural Polyphenol Cross-Linking Poly (vinyl alcohol) Films with Strong Integrated Strength and Toughness

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Water resistance properties

The weight swelling ratio of the samples was calculated using the following formula (1):

$$\text{Weight swelling ratio (\%)} = (W-W_0)/W_0 \times 100(\%) \quad (1)$$

where W_0 and W are the weights before and after dipping the samples in water for 24 hours at room temperature, respectively. The weight loss of the samples was calculated using the following formula (2):

$$\text{Weight loss (\%)} = (W_0-W_d)/W_0 \times 100(\%) \quad (2)$$

Where W_d is the weight of the sample dried at 35°C for 3 days under vacuum after the water dipping test.

Water contact angles (WCA) were measured with 2 μL droplets of water using a Krüss DSA 30 (Krüss Company, Ltd., Germany) device at ambient temperature.

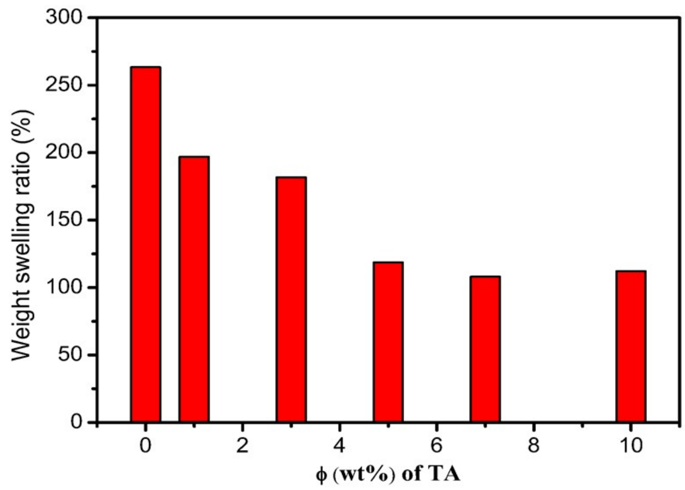

Figure S1. Weight swelling ratio of PVA and the PVA/TA composite films after water dipping test.

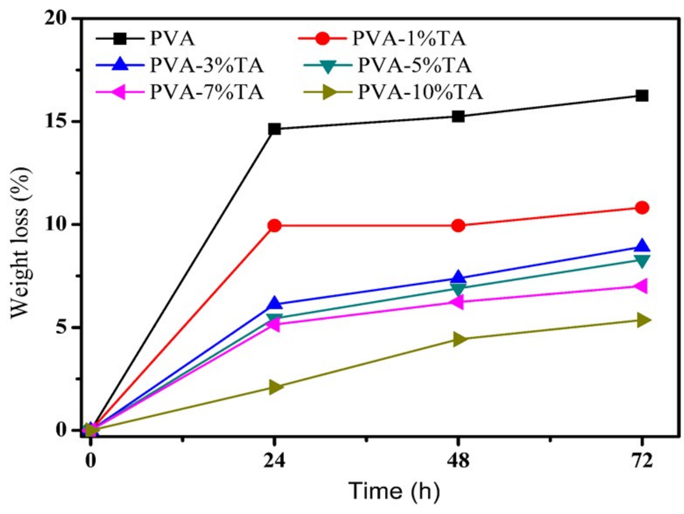

Figure S2. Weight loss of PVA and the PVA/TA composite films after water dipping test.

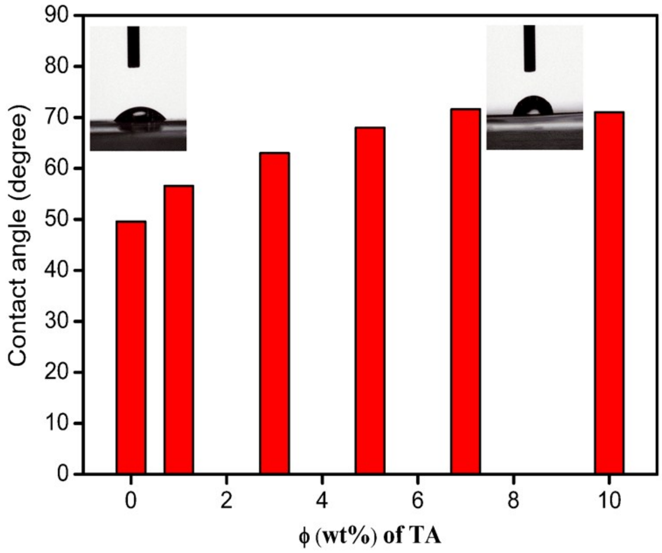

Figure S3. Water contact angles of PVA and the PVA/TA composite films.

The water resistance properties of the PVA nanocomposites were evaluated by measuring the weight swelling ratio and the weight loss from a water-dipping test. After dipping the samples, the difference in the swelling behavior for PVA and PVA/TA films could be clearly observed. The dimensions of PVA films increased much by the absorption of water molecules, while those of PVA/TA films did not change significantly with increasing of TA contents. Therefore, it is obvious that PVA films with TA cross-linked effectively prevents the swelling of PVA. In addition, the weight swelling ratio of PVA was found to decrease considerably from 263% to 112% (Figure S1), indicating that physically cross-linked by TA in PVA films could effectively decrease the water permeability of PVA because TA can work as a physical barrier to prevent the water transfer in the PVA matrix. The smaller weight loss (Figure S2) of the PVA/TA composites films compared with PVA further support the physical barrier effect.

The water contact angels of PVA/TA composites films were measured to further investigate the water resistance properties. The water contact angels of PVA was found to increase from 49.6^{o} to 56.6^{o}, 63.0^{o}, 68.0^{o}, 71.6^{o}, 71.0^{o}, by adding 1, 3, 5, 7, 10 wt% of TA (Figure S3), respectively. The results indicated that the hydrophilicity of PVA decreased by the addition of TA. Therefore, PVA/TA films have physical stability in water because TA can work as a physical barrier to water molecules transfer in PVA matrix.

References

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