Supporting Information

Poly (vinyl alcohol) Nanocomposites with Nanodiamond

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1. Sample preparation

Annealed PVA/ND nanocomposites. The dried as-cast PVA/ND nanocomposites were annealed in the oven at 200 ºC for 30 min.

2. RESULTS AND DISCUSSION

XRD. Figure S1 shows the X-ray diffraction profiles of the annealed PVA film, the PVA/ND nanocomposites and the ND particles. The diffraction peaks assigned as PVA reflections appeared more clearly and more sharply compared with those of as-cast ones. This suggests that the crystallinity (*X*c) of the PVA matrix increased by annealing. The *X*c of the annealed PVA film, the nanocomposite with 1 wt% and 5 wt% ND loading were 57 %, 61 % and 63 %, respectively.

Mechanical properties. Figure S2a shows the stress (σ) –strain (ε) curves of annealed PVA film and PVA/ND nanocomposites with different ND contents. For most of the samples, the E and the σ_{max} increased when they were annealed. Figure S2b shows the relationships between the E, the σ_{max} and the ND content of the PVA/ND nanocomposites. The E value of the annealed nanocomposite with 1 wt% ND loading increased 180 % compared with that of the as-cast PVA film (Table S1). Besides the reinforcement effect of the ND particles, the mechanical properties of the annealed nanocomposites correspond to the increase of the *X*c of the PVA matrix as shown above.

Table S1 summarizes the mechanical properties of the annealed PVA film and the PVA/ND nanocomposites. Generally, the Young's modulus (*E*) and the tensile strength (σ_{max}) values increase when rigid nanofiller are incorporated in polymer matrix. At the same time, the elongation at break (ε_{max}) value decreased with the increasing of the filler content sequentially causing the drastic decrease of the *K* value. However, for the PVA/ND nanocomposites, the *K* value was remained together with the remarkable increase with the *E* and σ_{max} values.

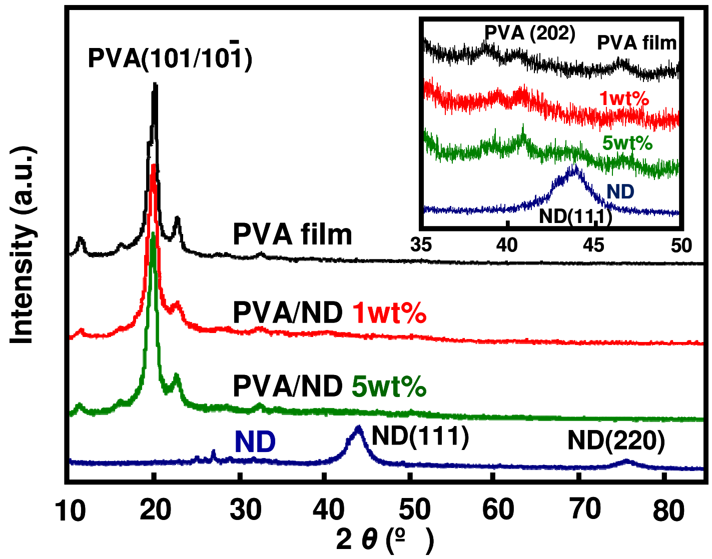

Figure S1. X-ray diffraction profiles of annealed PVA film, PVA/ND nanocomposites and ND particles.

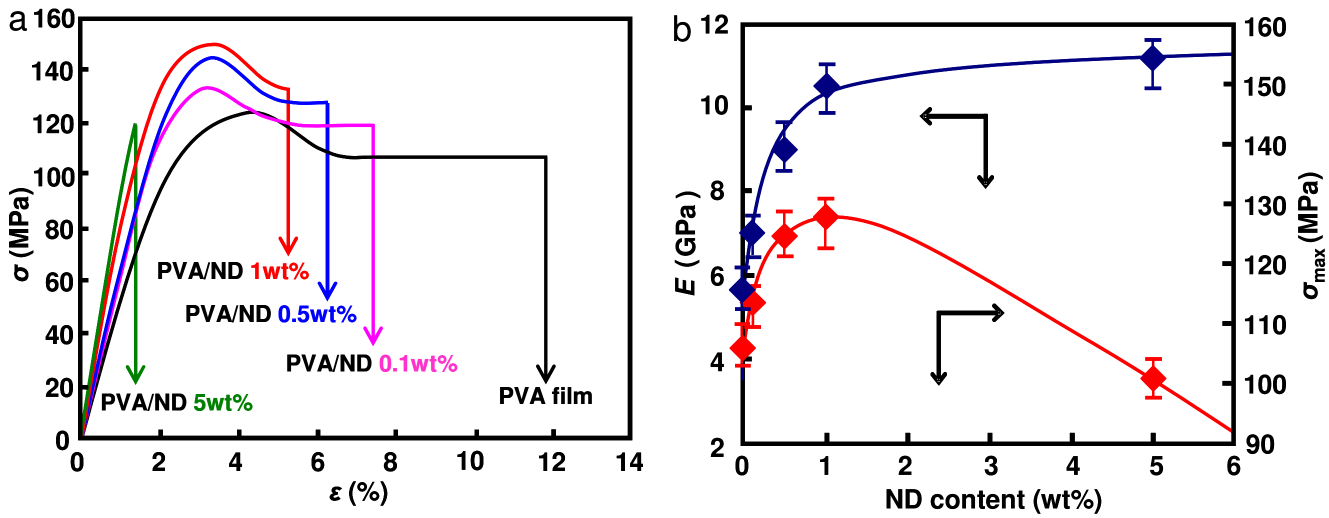

Figure S2. a) Stress (σ)-strain (ε) curves of annealed PVA film and PVA/ND nanocomposites; **b)** Relationship between Young's modulus (E), tensile strength ($\sigma_{\max}$) and ND content of annealed PVA/ND nanocomposites.

Table S1. Young's modulus (E), tensile strength (σ_{max}), strain at break (ε_{max}) and toughness (K) of annealed PVA film and PVA/ND nanocomposites.

	E	σ_{max}	ε_{max}	K
	GPa	MPa	%	J/g
Annealed				
PVA	5.7 ± 0.3	124 ± 3.7	12 ± 1.1	9.3
PVA/ND 0.1 wt%	7.1 ± 0.7	133 ± 8.9	7.4 ± 1.4	5.9
PVA/ND 0.5 wt%	8.7 ± 0.6	145 ± 4.9	6.2 ± 0.6	5.2
PVA/ND 1 wt%	10.5 ± 0.7	148 ± 3.1	4.9 ± 1.2	4.2
PVA/ND 5 wt%	11.1 ± 0.8	121 ± 8.8	1.3 ± 0.6	0.7