

Supporting Information

Thermally conductive, super flexible and flame-retardant BN-OH/PVA composite film reinforced by lignin nanoparticles

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Fig. S1 Preparation process of BN-OH.

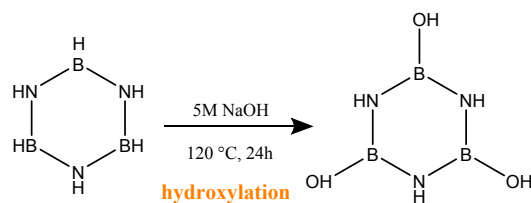


Fig. S2 (a) Particle size distribution; (b) FT-IR spectrum; (c) TG and DTG curves of LNPs.

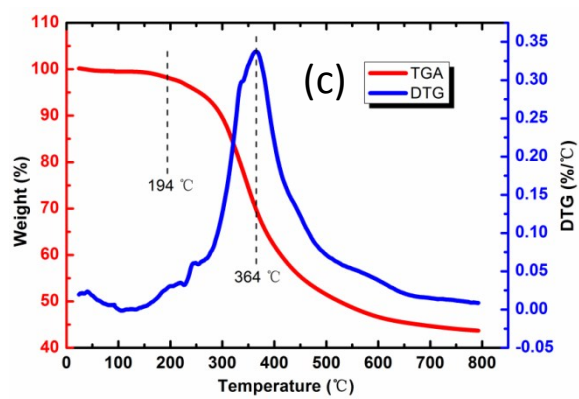
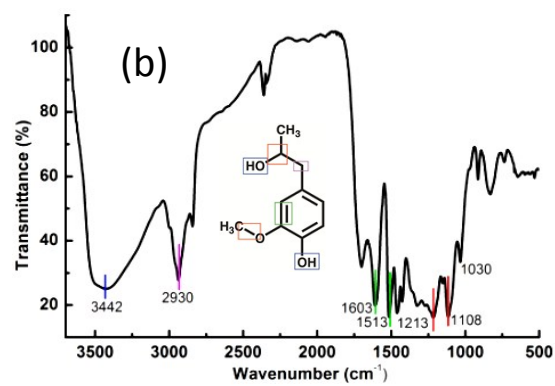
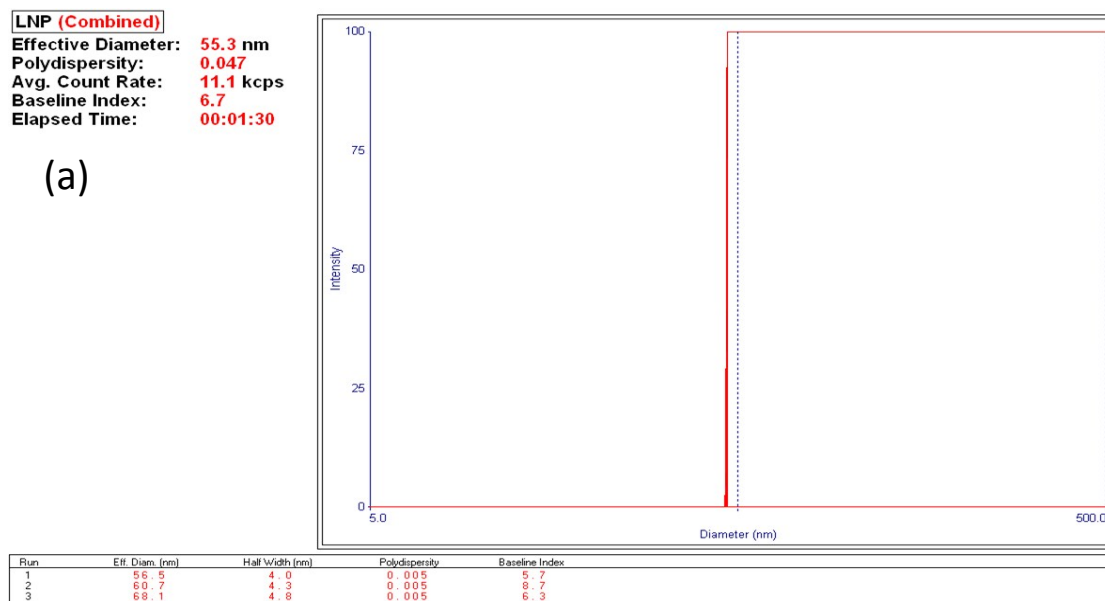


Fig. S3 (a) FT-IR spectrum; (b) TG curves of bulk h-BN and BN-OH.

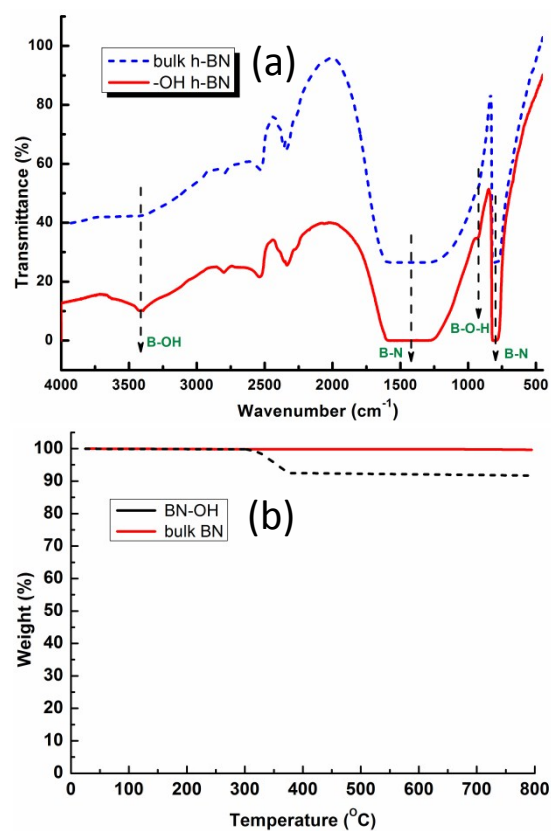


Fig. S4 SEM images of (a) bulk h-BN and (b) BN-OH, respectively.

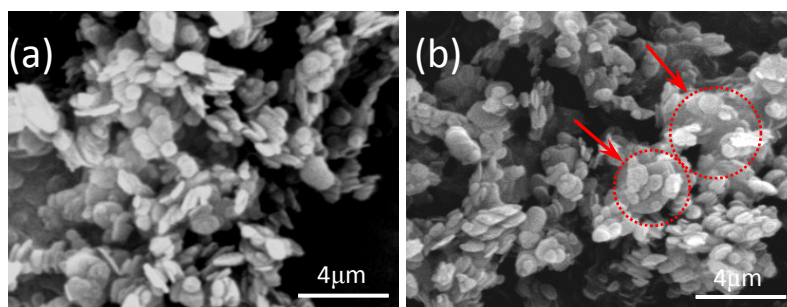


Fig. S5 Surface SEM images of BN-OH/PVA/LNPs composite films with LNPs loadings of (a) 0 vol%, (b) 2.5 vol% and (c) 18.6 vol%, respectively.

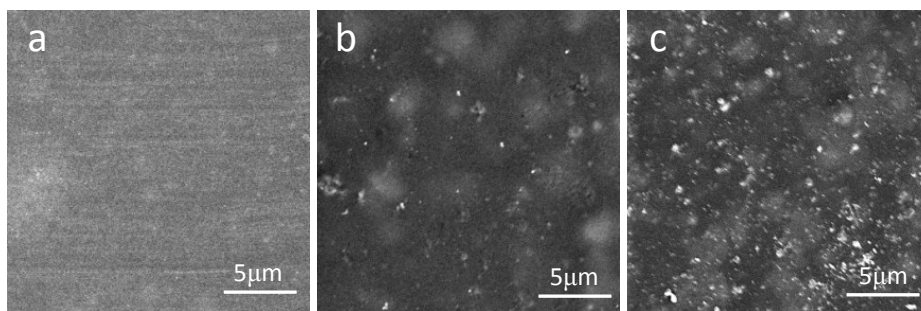


Fig. S6 (a) Backward SEM image of BN-OH/PVA/LNPs composite film with LNPs loading of 18.6 vol%; (b), (c) and (d) cross-section SEM images of BN-OH/PVA/LNPs composite films with LNPs loadings of 0 vol%, 2.5 vol% and 18.6 vol%, respectively.

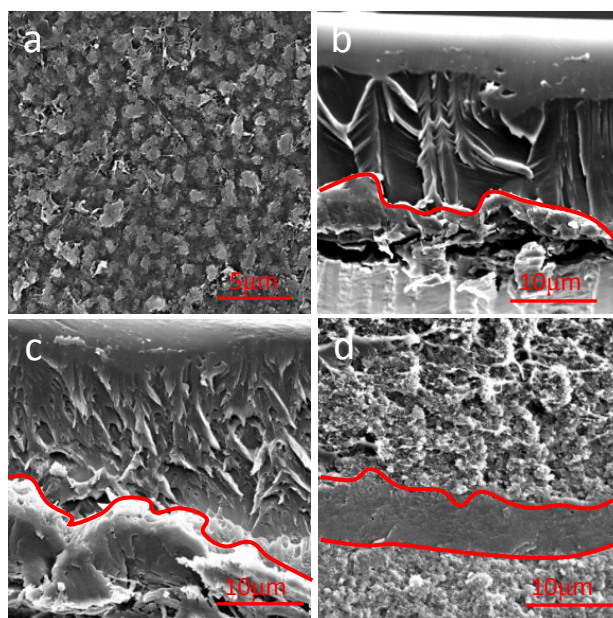


Fig. S7 Cross-section CLSM image of BN-OH/PVA/LNPs composite film with LNPs loading of 2.5 vol%.

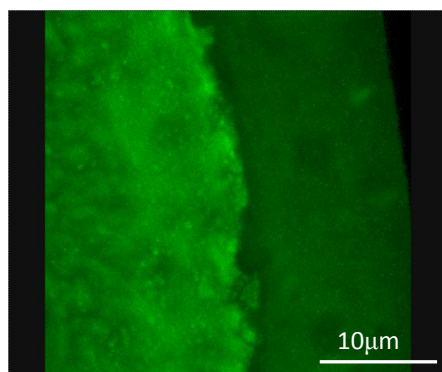


Fig. S8 DSC thermograms of PVA film, BN-OH/PVA/LNPs composite films with different LNPs loading.

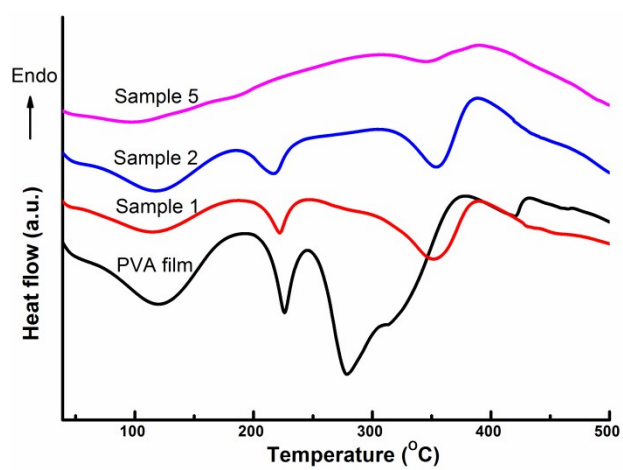


Fig. S9 Elemental analysis of Fig. 5e.

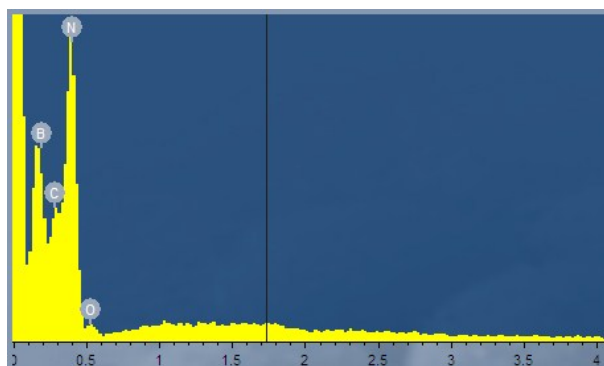


Table S1. The PVA, BN-OH, and LNPs content in BN-OH/PVA/LNPs composite films.

Sample	Cross-linking time	PVA content	PVA content	BN-OH content	BN-OH content	LNP content	LNP Content
	(h)	(vol%)	(wt%)	(vol%)	(wt%)	(vol%)	(wt%)
1	2	73.2	84.6	26.8	15.4	0	0
2	2	71.4	82.5	26.2	15.0	2.5	2.5
3	2	68.0	78.6	24.9	14.3	7.1	7.1
4	2	63.6	73.3	23.2	13.3	13.2	13.3
5	2	59.6	68.8	21.8	12.5	18.6	18.8
6	0	71.4	82.5	26.2	15.0	2.5	2.5
7	0	68.0	78.6	24.9	14.3	7.1	7.1
8	6	71.4	82.5	26.2	15.0	2.5	2.5
9	6	68.0	78.6	24.9	14.3	7.1	7.1

Table S2. The influence of LNPs loading on thermal conductivity of BN-OH/PVA/LNPs composite films at 25 °C.

BN-OH weight	Temperature	LNP content	Specific Heat	Thermal Diffusivity	Density	Thermal conductivity
(g)	(°C)	(vol%)	(J/gk)	(mm ² /s)	(g/m ³)	(W/mK)
0.06	25	0	1.581	0.917 ± 0.003	1.140	1.653 ± 0.005
		2.5	1.514	0.987 ± 0.004	1.166	1.742 ± 0.007
		7.1	1.538	0.787 ± 0.003	1.099	1.331 ± 0.005
		13.2	1.521	0.623 ± 0.004	1.072	1.016 ± 0.008
				0.330 ± 0.001		0.532 ± 0.001
		18.6	1.590		1.013	