Supplementary Information

High temperature thermal conductive nanocomposite textile by "green" electrospinning

Authors

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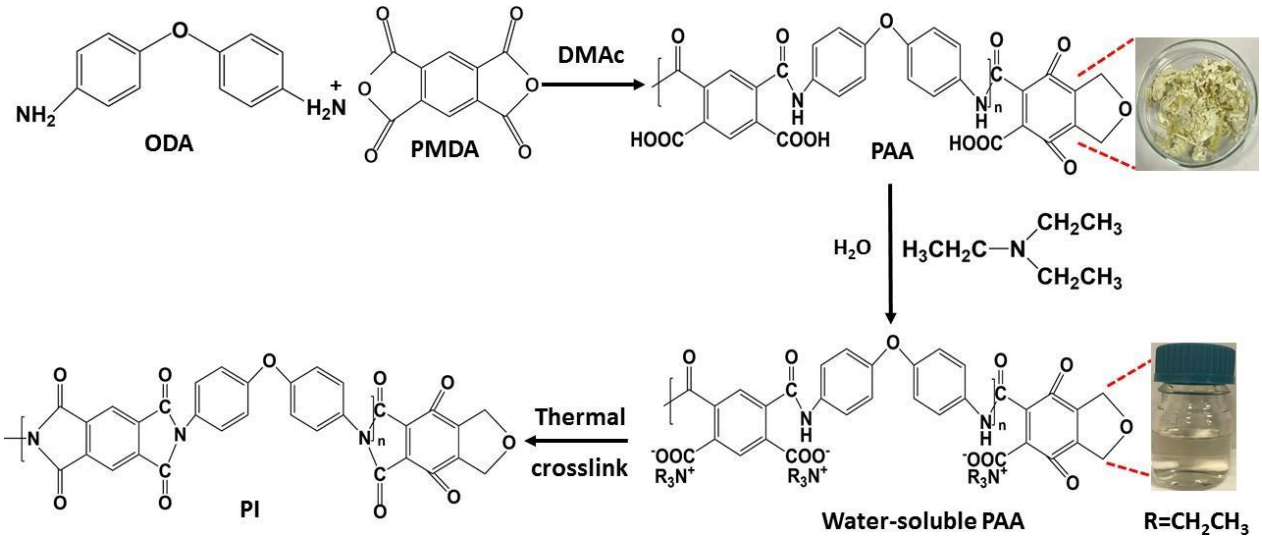

Scheme. S1. The reaction scheme of the water-soluble PI precursor (PAA) and optical images of PAA before and after modification.

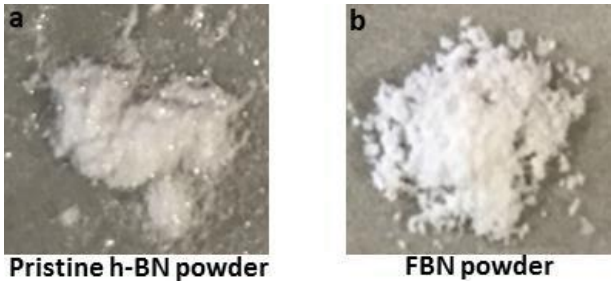

Fig S1. Optical images of prinstine h-BN and FBN powders. (a) h-BN powder, (b) FBN powder.

From the optical images, it could be seen that the FBN powders are more fluffy without shining large crystals existing in the pristine h-BN powders.

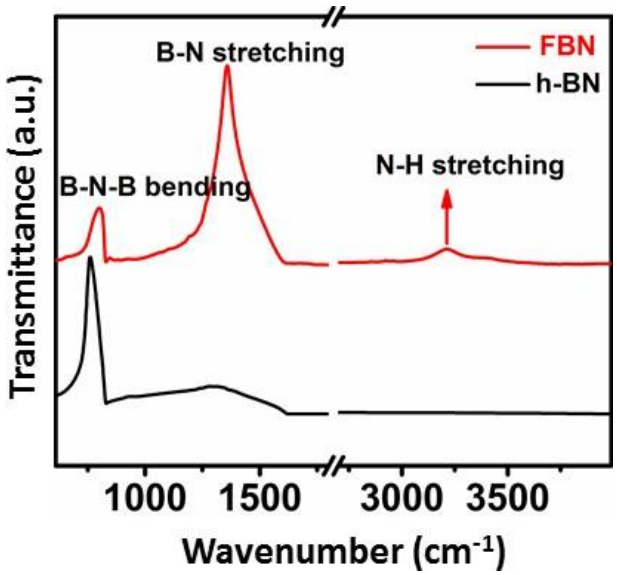

Fig S2. FTIR spectrum of FBN and prinstine h-BN.

The FTIR spectrum suggests an additional peak at 3,240 cm^{-1} owing to the N–H stretching vibration, whereas pristine h-BN shows only the characteristic peaks of in-plane B–N stretching vibrations at around 1,360 cm^{-1} and out-of-plane B–N–B bending vibrations at arounf 800 cm^{-1}.

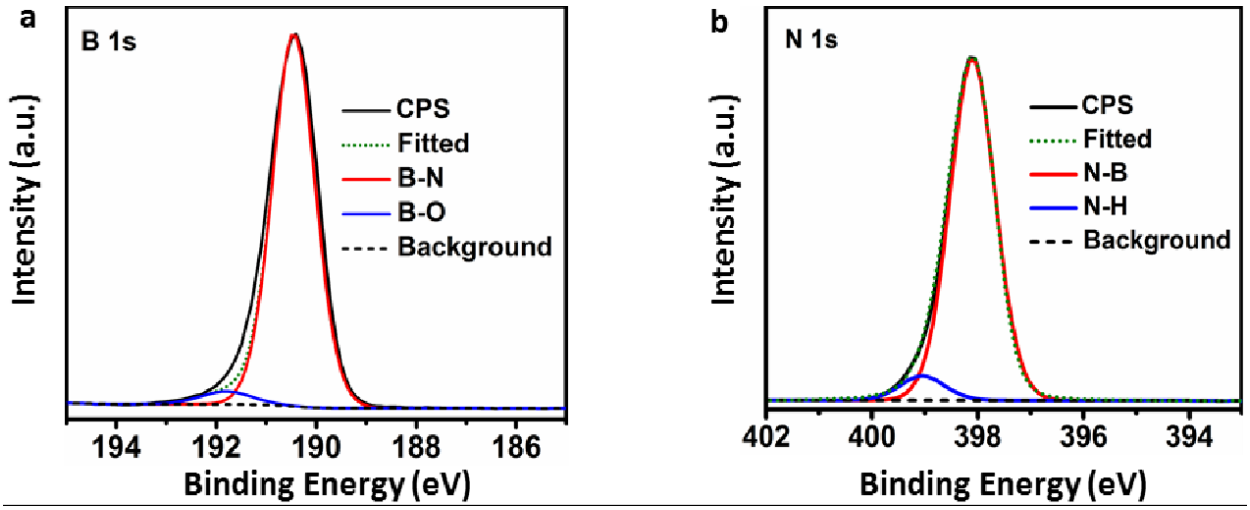

Fig S3. XPS spectrum of FBN. (a) B 1s and (b) N 1s of FBN XPS analysis.

In B1s spectrum, the component at 190.4 eV corresponds to B–N bonds and the band at around 191.8 eV is B atoms in B–O bonds owing to the exposure of the few-layered BN to ambient environment and the hydroxyl groups attached to defects along the edges of h-BN during washing in water after ball milling. In N1s spectrum, the main peak at 398.1 eV in the N 1s spectrum corresponds to N–B bonds. While a band deconvoluted at 399.2 eV corresponds to N–H bonds, which is another evidence of presence of amino group.

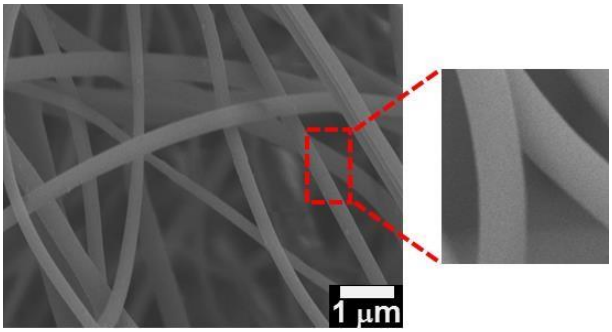

Fig S4. SEM images of pure PI fibre. The electro-spinning pure PI nanofibre has a diametre of 200-400 nm. The surface of the fibre is smooth without any platelets attached.

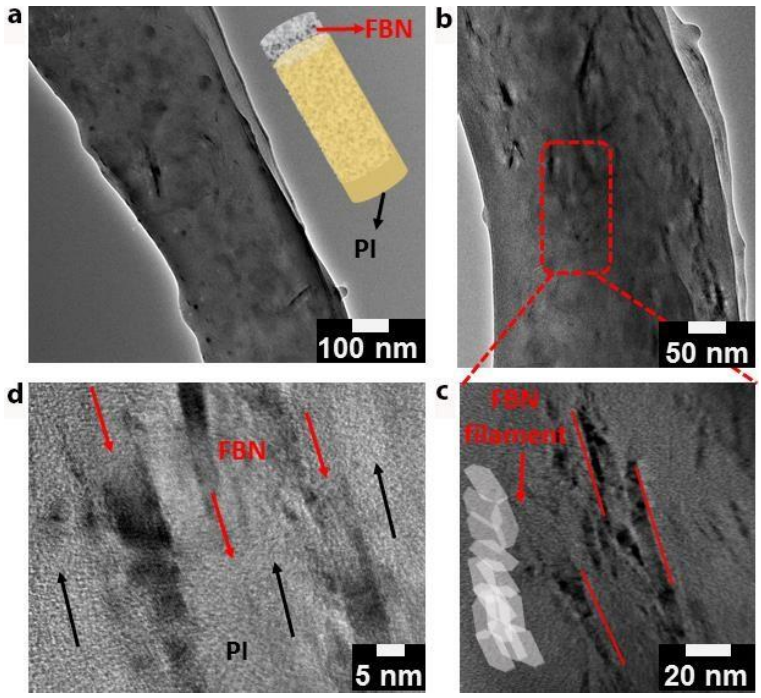

Fig S5. TEM images of FBN-PI fibre. (a, b) TEM images of FBN-PI fibre. It indicates that there is FBN filament network throughout the fibre structure (inset of Fig. S3a). (c, d) HRTEM images of FBN-PI fibre. It could be seen that FBN nanosheets are well aligned and fused with the PI matrix. The architecture suggests that the stacking FBN nanosheets form the oriented filaments (inset of Fig. S3c), which are evenly distributed among the PI matrix.

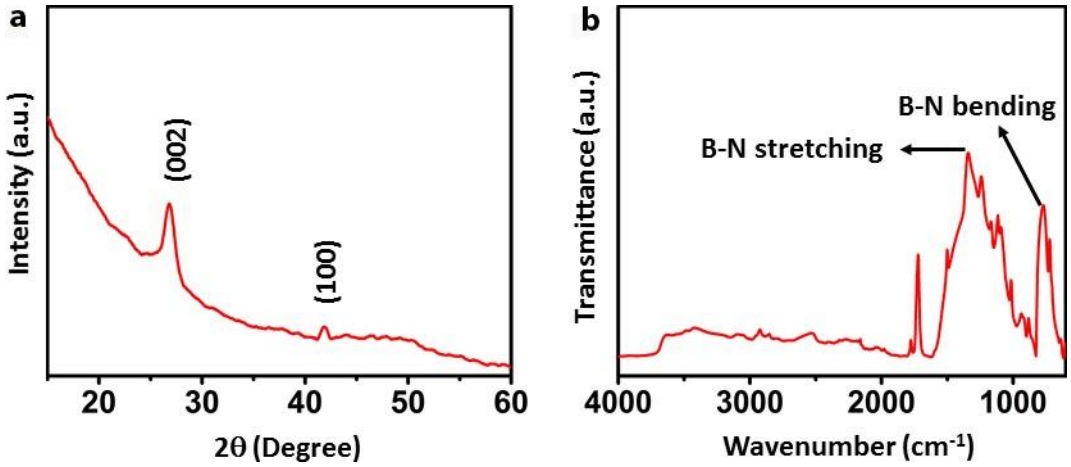

Fig S6. XRD pattern and FTIR spectrum of FBN-PI textile. (a) XRD pattarn, (b) FTIR spectrum of FBN-PI textile. From XRD pattern, it could be seen that there are two characteristic peaks of (002) and (100) at 26.1° and 41.5° respectively, reflecting the presence of FBN in the fibre. The FTIR spectrum also indicates there are characteristic bands of FBN with B-N stretching (at 1360 cm^{-1}) and B-N bending (at 800 cm^{-1}).

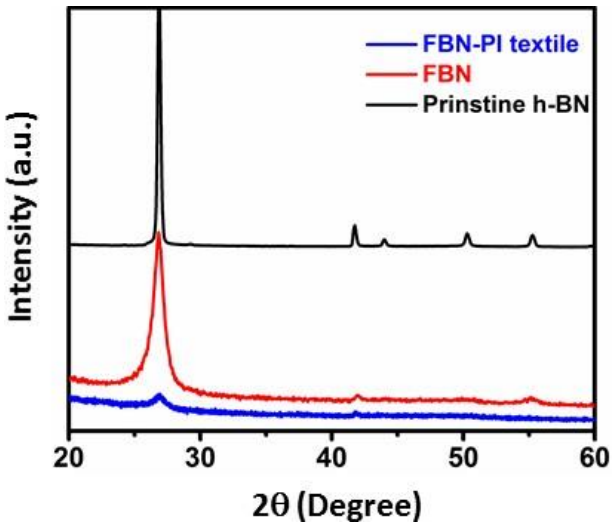

Fig S7. XRD patterns comparsion of FBN-PI textiles, FBN and pristine h-BN.

Obviously, the characterized peak of FBN-PI textile becomes more broaden with reduced intensity in the FBN-PI textile. For one thing, the reduced intensity and broaden peak ascribe to the fewer contents of FBN in the FBN-PI textiles than the pure FBN. For another, the (002) peak shifts to a higher diffraction angle, indicating that, in the FBN-PI textiles, the spacing between the layers of FBN slightly decreases owing to the incorporation of PI chains, which demonstrates the good compatibility and interaction between FBN and PI. Hence, it could be inferred that there is no BN aggregation in the nanocomposite textile. Moreover, no pointed characteristic peak of pristine h-BN is observed in the FBN-PI textiles, which also suggests no bulk BN in the textile after thermal crosslinking.

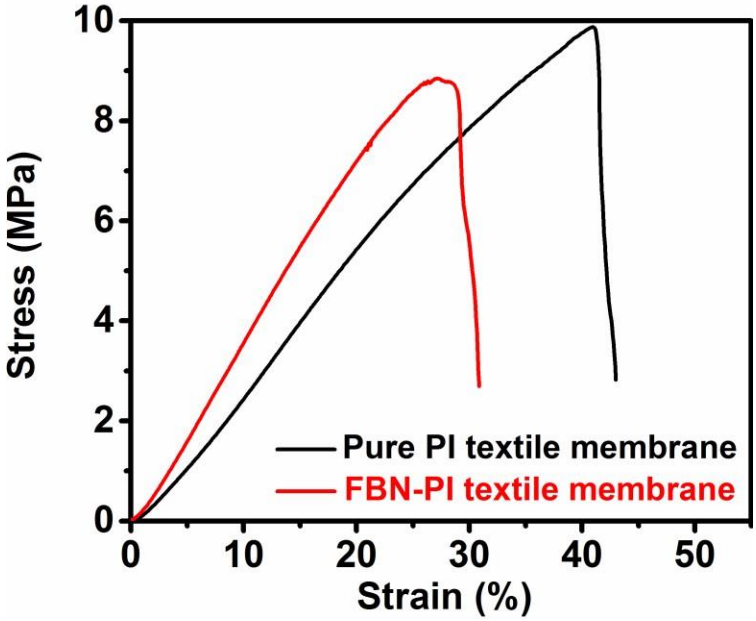

Fig S8. Mechanical performance of FBN-PI textile. It shows that both strain and stress decrease with the addition of FBN nanosheets. Because FBN nanosheets, which are brittle and fragile, form filaments in the composite fibre, thereby leading to the reducing of the mechnical performance. Considering it, we set the amount of FBN to 20 wt%.

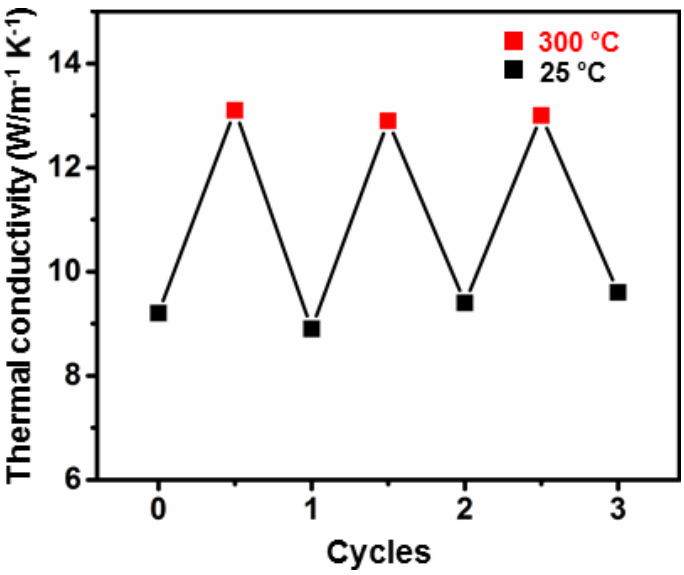

Fig S9. Cycle stability of the thermal conductivity of FBN-PI textile.

It could be seen that the thermal conductivity remains nearly no change after 3 cycles between 25°C and 300°C, demonstrating the good stability.