Intensive and Thermal Conductive Boron Nitride/Aramid Nanofiber Composite Fiber Fabricated *via* Wet Spinning Technique

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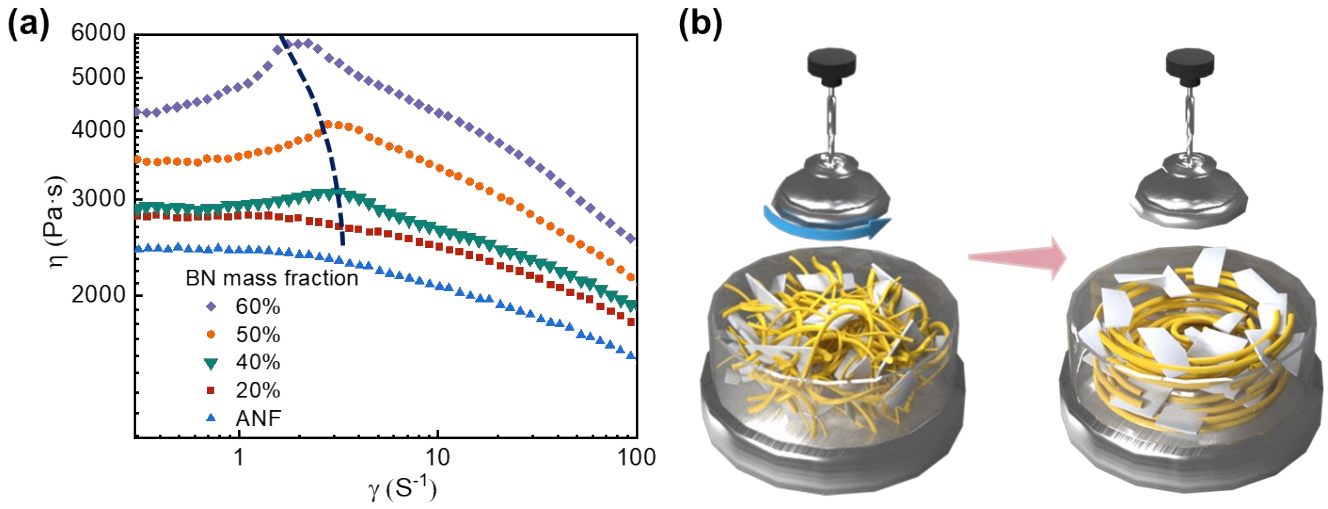

Fig. S1. (a) Shear-viscosity curves of pure ANF dispersions and BN/ANF dispersions with different BN mass fractions. (b) Schematic representation of the arrangement of ANF and BN nanosheets within the dispersion under shearing force.

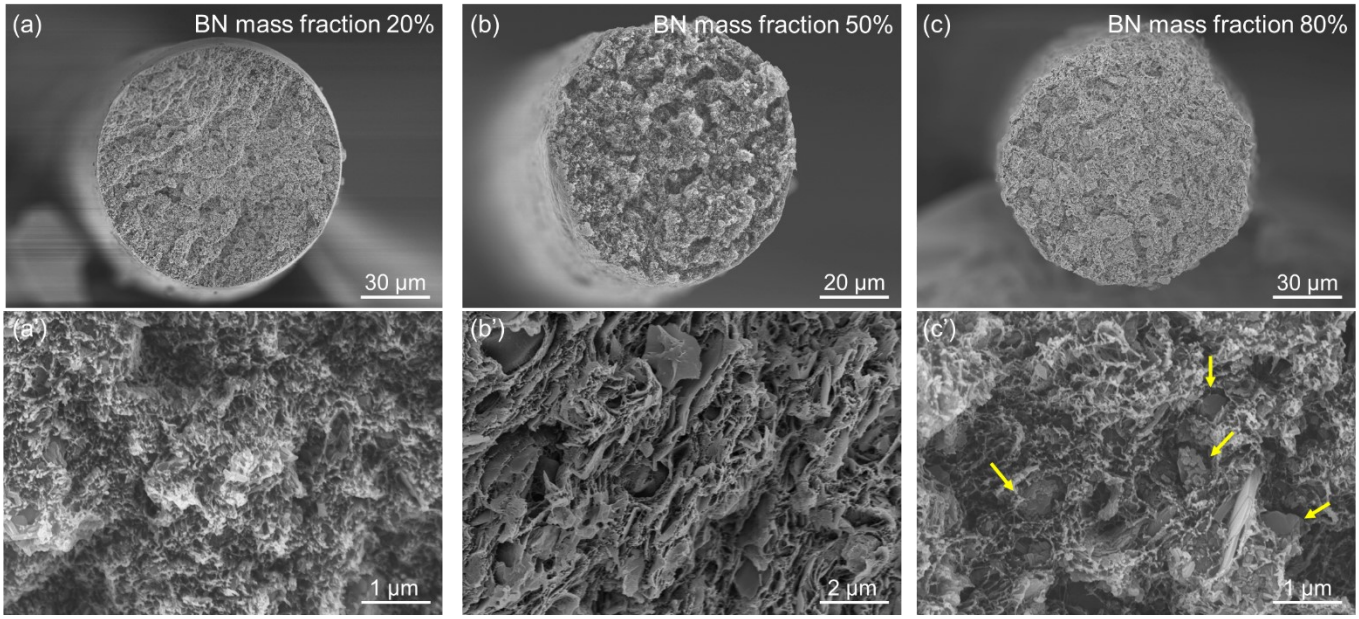

Fig. S2. The cross-sectional (Top) and the corresponding magnified (below) SEM images of the BN/ANF composite fibers.

The cross-sectional SEM images of composite fibers with different BN contents are illustrated in Fig. S2. When the BN content reaches 80 wt%, BN sheets are aggregated and the ANF content is too low to effectively encapsulate BN and provide mechanical support, as marked by yellow arrows in image c'.

Consequently, there is a significant presence of undispersed BN nanosheet clusters within the fibers, severely impacting the mechanical performance of the fibers. On the other hand, as the BN content is only 20 wt%, it is too low to observe the formation of effective thermal transfer pathways composed of BN nanosheets. In contrast, at a BN content of 40 ~ 60 wt%, BN is uniformly dispersed within the fibers, and observed physical contact between nanosheets, form efficient phonon transfer channels.

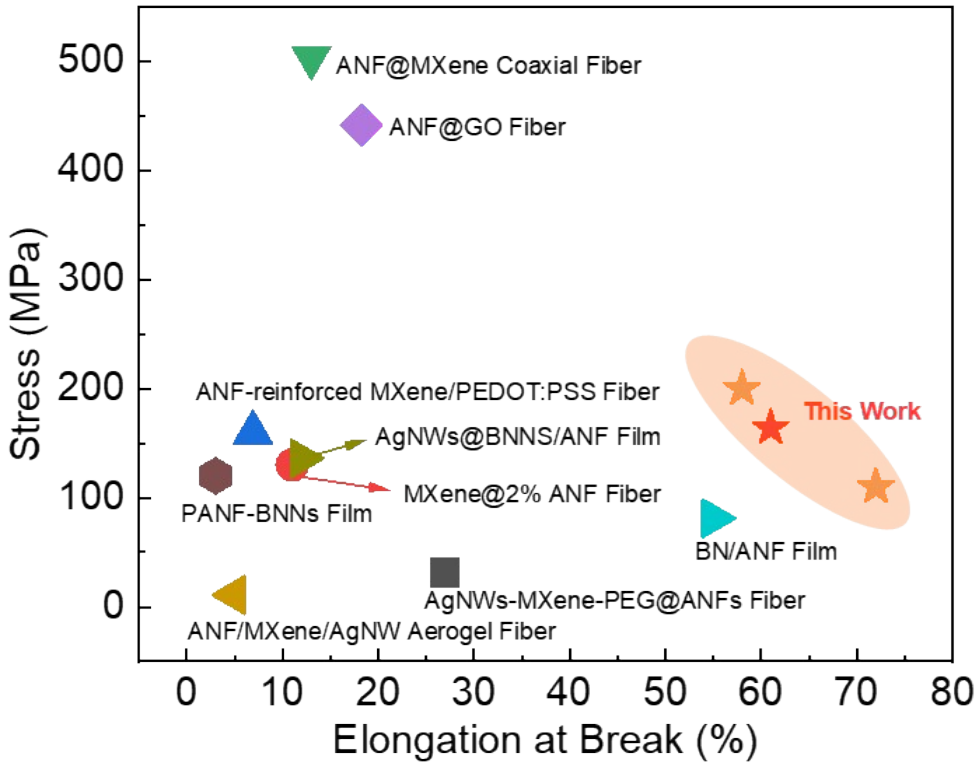

Fig. S3 Comparison of mechanical properties: BN/ANF composite fibers compared with prior ANF-based composites and BN/ANF films. (Materials for comparison can be found in the References No. 4, 5, 26-28, 35, 39, 40, 47 in the manuscript.)

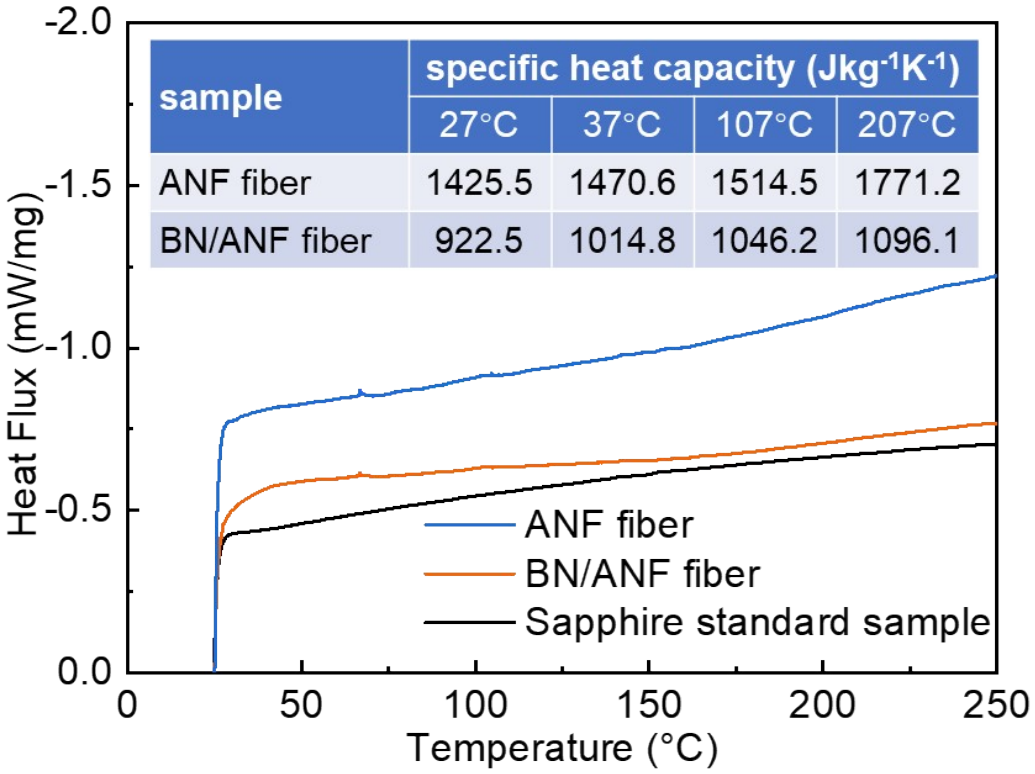

Fig. S4. The DSC curves of ANF fibers and BN/ANF fibers, along with their specific heat capacities at various temperatures.

The specific heat capacity of the fibers is measured by DSC sapphire method. Three-step test method is adopted to minimize the interference caused by the instrument and the test process. At the same time, because the sapphire standard is pure single crystal alumina, the physical and chemical properties are very stable, which can improve the accuracy of the specific heat capacity of the DSC test substance.

At the same heating rate, the DSC spectra of the blank crucible was first tested as the baseline, then the sapphire standard was tested, and finally the test sample was tested.

The calculation adopted the equation S1,

$$C_p^F = C_p^S\left(\frac{m_S}{m_F}\right)\left[\frac{P_F - P_E}{P_S - P_E}\right] \quad \text{(S1)}$$

Where, C_p^F and C_p^S are the specific heat capacity of the sample and the sapphire standard sample (J $kg^{-1}K^{-1}$), m_F and m_S are the mass of the sample and the sapphire standard (kg), P_F, P_S, P_E are the heat flow of the sample, sapphire standard, and empty crucible.

The results show that the specific heat capacity of the composite fiber decreased significantly after adding BN nanosheets. It indicates that BN/ANF fabrics have higher thermal responsiveness to external temperature changes.

We calculate its value by measuring the image dimensions of the BN/ANF composite fibers and the mass using a microbalance. When the BN mass fraction is 50%, the composite fiber density is approximately 1.45 g/cm^3.

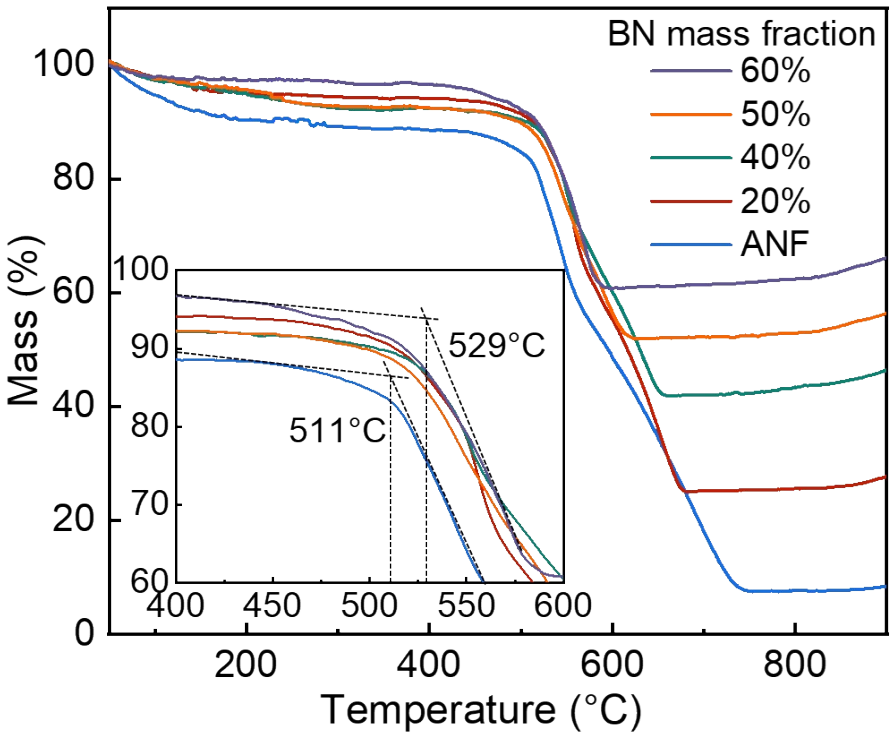

Fig. S5. Thermogravimetric curves of pure ANF fibers and BN/ANF fibers with different BN mass fractions.