Electronic Supplementary Material (ESI) for Soft Matter.

Supplementary Material

Porous boron nitride nanofibers as effective nanofillers for poly(vinyl alcohol) composite hydrogels with excellent self-healing performances

Xiangqian Gao,[a,b] Tiantian Deng,[a,b] Xindi Huang,[a,b] Mengmeng Yu,[a,b] Danyang Li,[a,b] Jing Lin,[*a,b] Chao Yu,[a,b] Chengchun Tang [a,b] and Yang Huang [*a,b]

[a] School of Materials Science and Engineering, Hebei University of Technology, Tianjin 300130, P. R. China

[b] Hebei Key Laboratory of Boron Nitride Micro and Nano Materials, Hebei University of Technology, Tianjin 300130, P. R. China

* Corresponding author. E-mail: huangyang@hebut.edu.cn (Y.H.) linjing@hebut.edu.cn (J.L.)

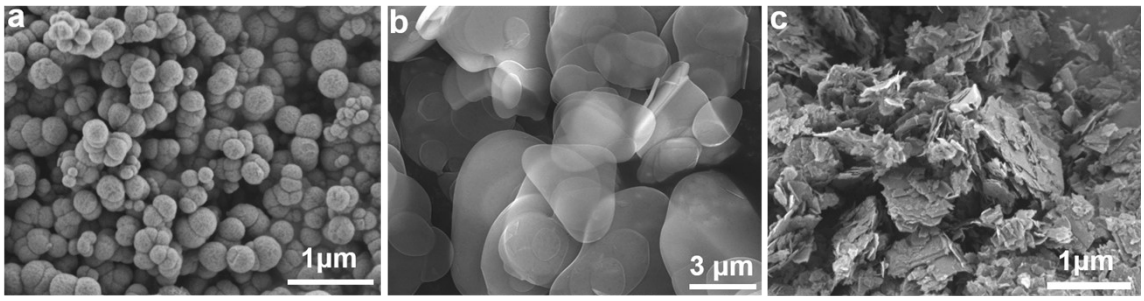

Fig. S1 SEM images of (a) BNNPs prepared by CVD reaction of trimethoxyborane with NH_3 [1], (b) commercial hBN and (c) BNNSs prepared by boric acid assisted ball milling [2].

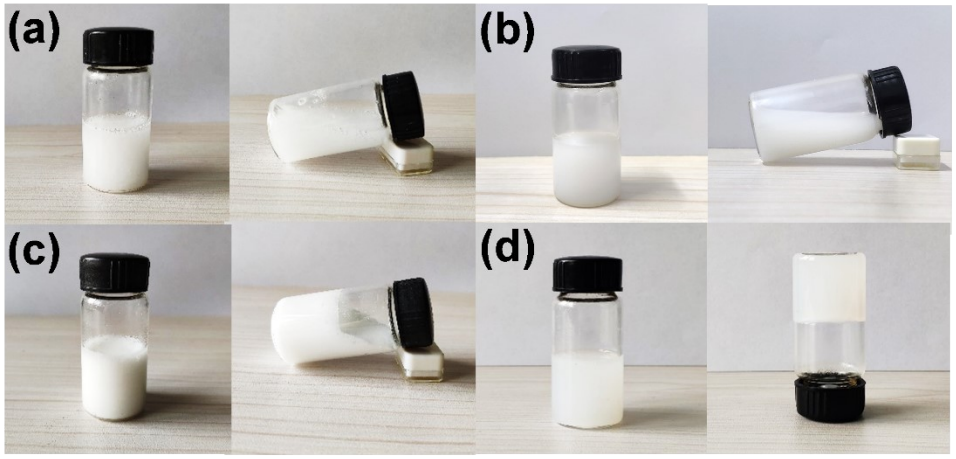

Fig. S2 (a) The optical photograph of the commercial hBN/PVA composite with 1 wt% of hBN. (b) The optical photograph of the BNNSs/PVA composite with 1 wt% of BNNSs. (c) The optical photograph of the BNNPs/PVA composite with 1 wt% of BNNPs. (d) The optical photograph of the BNNFs/PVA composite with 1 wt% of BNNFs.

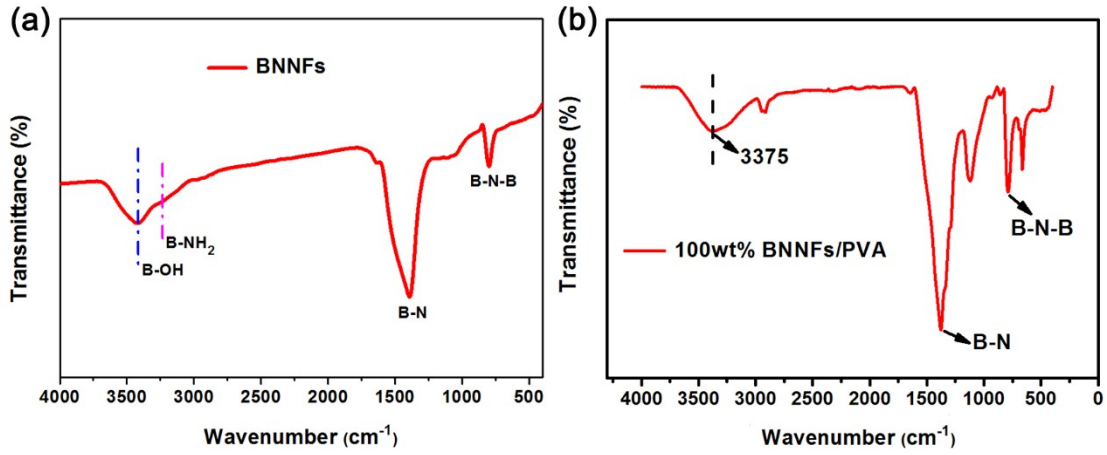

Fig. S3 FTIR of (a) BNNFs, (b) BNNFs/PVA composite hydrogel containing 100 wt% of BNNFs.

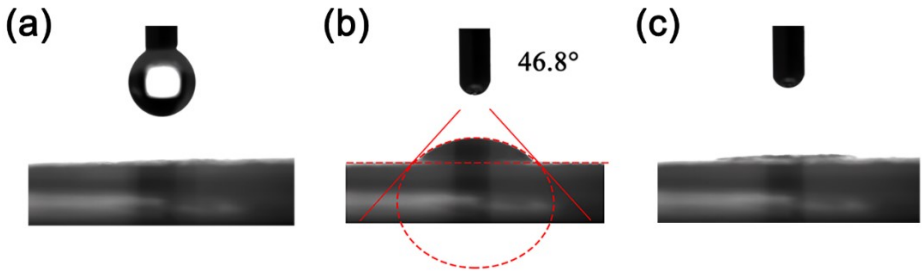

Fig. S4 The hydrophilic test of BNNFs film: The water drops (a) drop from the beginning, (b) contact the surface of BNNFs film for 1 second that the contact angle is 46.8°, (c) contact the surface of BNNFs film for 3 seconds that the water drops disappear.

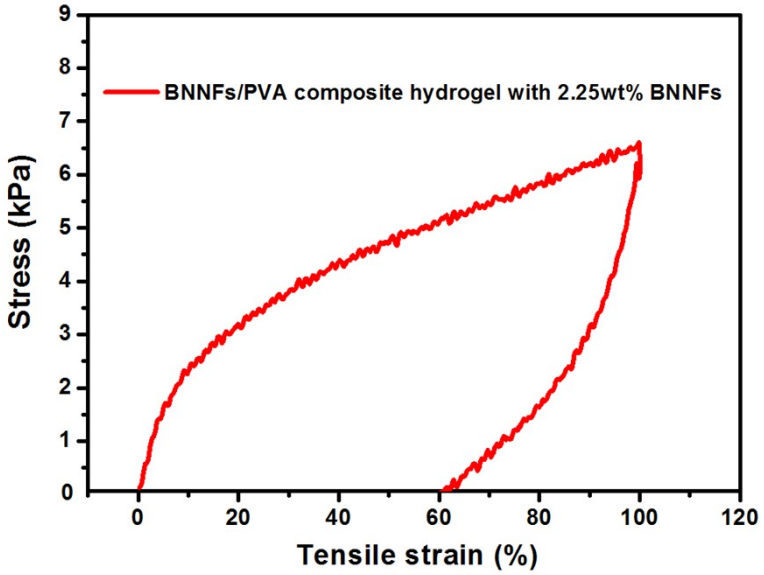

Fig. S5 Loading–unloading stress–strain curves of BNNFs/PVA composite hydrogels with 2.25wt% BNNFs at applied strain of 100%.

The samples are a cube with a length of 6 cm, a width of 1.2 cm and a height of 0.7 cm. The samples were tested (100 mm·min^{-1}) with gauge length of 1.5 cm. The recoverable elastic deformation is ~40.3% at tensile strain of 100%, indicating that the elasticity of the composite hydrogel is very weak.

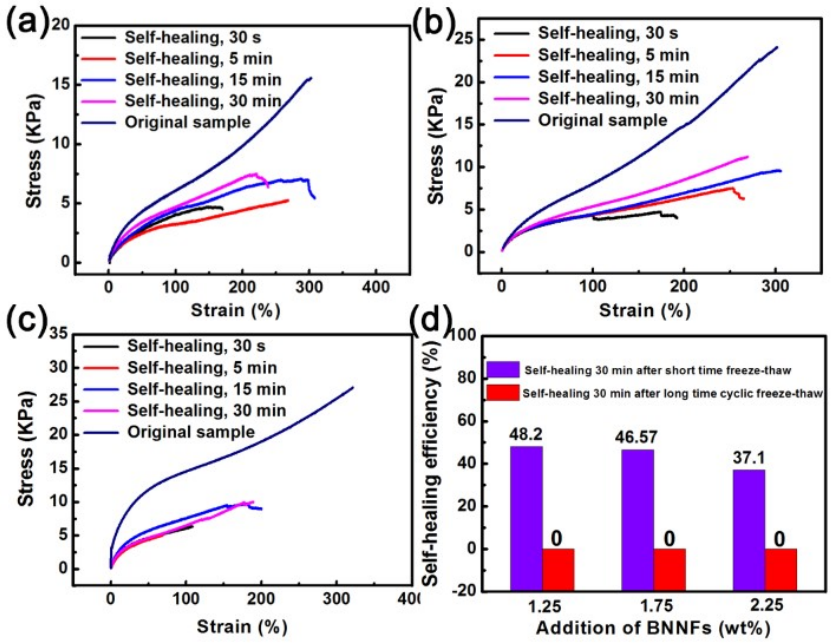

Fig. S6 The tensile curves of BNNFs/PVA hydrogels with different contents of BNNFs after short-time freeze-thaw: (a) 1.25 wt%, (b) 1.75 wt%, (c) 2.25 wt%. (d) The self-healing efficiencies of the hydrogels treated with short time freeze-thaw and long time cyclic freeze-thaw after self-healing for 30 minutes.

In order to compare the self-healing properties of BNNFs/PVA composite hydrogels prepared by different methods, two kinds of BNNFs/PVA composite hydrogels were prepared by freeze-thaw method. The self-healing performance was tested in the same way as before.

Short time freeze-thaw for one time: 10 g of PVA was added into the BNNFs dispersion solution and stirred at 95°C for 2 h. The BNNFs of contents were 1.25, 1.75, 2.25 wt% (BNNFs:PVA), respectively. Finally, the mixed solution was poured into a beaker and subjected to one cycle of freezing at −21°C for 1h and thawing at room temperature for 3h.

Long time freeze-thaw for three time: 10 g of PVA was added into the BNNFs dispersion solution and stirred at 95°C for 2 h. The BNNFs of contents were 1.25, 1.75, 2.25 wt% (BNNFs:PVA), respectively. Finally, the mixed solution was poured into a beaker and subjected to three cycles of freezing at −21°C for 12h and thawing at room temperature for 3h.

Reference

1. C. C. Tang , Y. Bando , Y. Huang , C. Y. Zhi and D. Golberg , *Adv. Funct. Mater.*, 2008, **18** , 3653–3661 .
2. C. C. Cao , Y. M. Xue , Z.Y. Liu , Z. Zhou , J.W. Ji , Q.Q. Song , Q. Hu , Y. Fang and C. C. Tang , *2D Mater.*, 2019, **6** , 035014 .