

Supplementary Information

Effects of boron nitride nanotube content in waterborne polyurethane-acrylate composite coating materials

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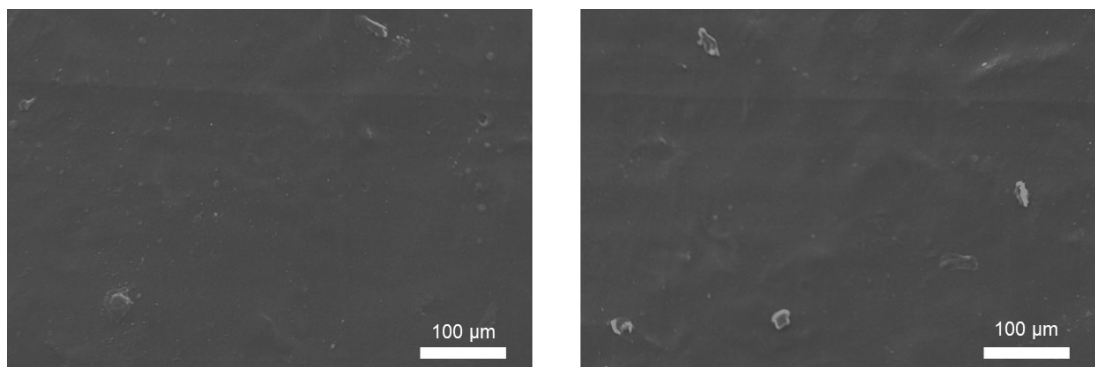


Fig. S1. SEM images of the bottom surface of the 2.5 wt% BNNT/WPUA composite film showing smooth surface without exposed fillers.

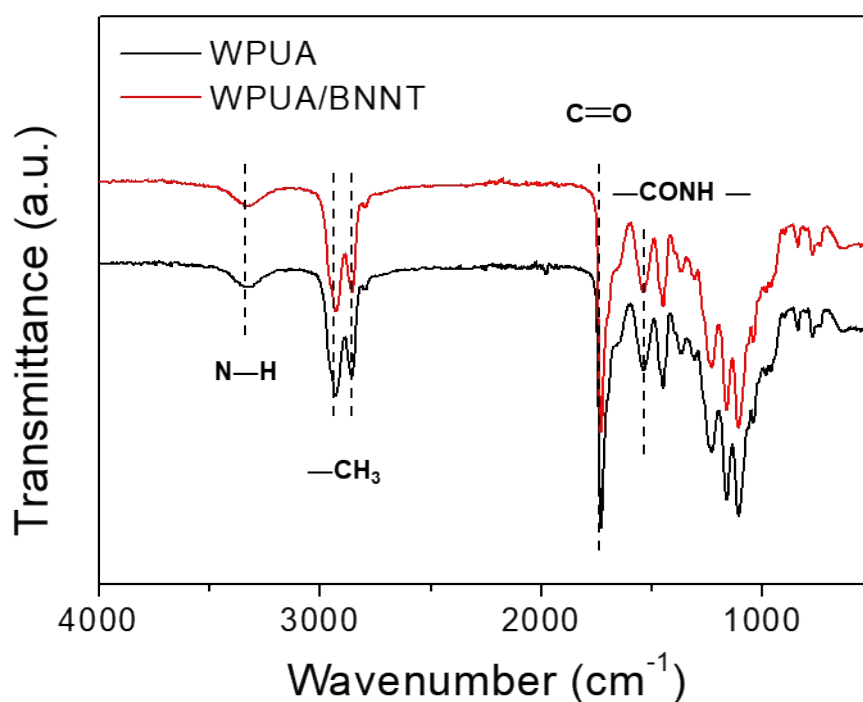


Fig. S2. FT-IR spectrum of the WPUA and WPUA/BNNT composite films. The broad absorption bands at 1532 cm^{-1} could be associated with the stretching vibrations of the —CONH— group in the urethane segments. The bands at 2930 cm^{-1} and 2856 cm^{-1} exhibited CH_3 peak and the band at 1727 cm^{-1} was ascribed to carbonyl CO stretching vibration of acrylic ester groups in the WPUA spectrum. The B-N and B-N-B position could not specified at 1390 and 813 cm^{-1} .

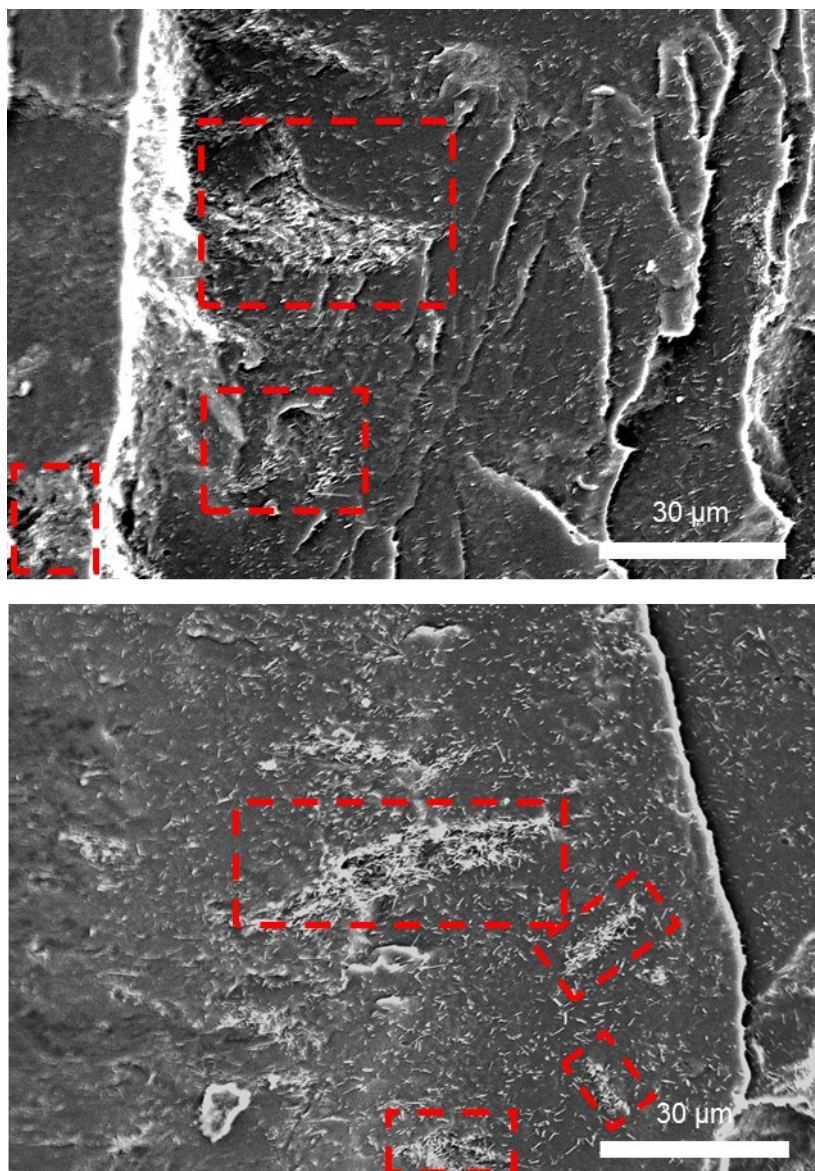
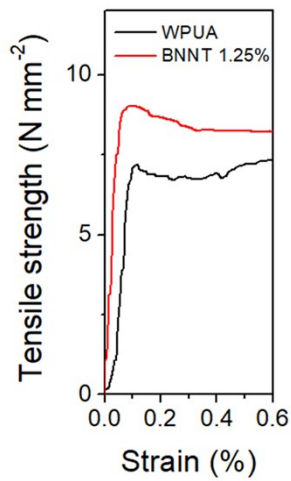


Fig. S3. Cross-sectional SEM images of the 5 wt% BNNT/WPUA composite film showed a large amount of phase-separated BNNT bundles in WPUA matrix.



Filler type	Yield stress (MPa)	Young's modulus (GPa)
None	7.17	12.0
BNNT 1.25%	9.03	16.4

Fig. S4. Stress-strain curve of WPUA and 1.25 wt% BNNT/WPUA composite showing elastic region and results of Yield stress and Yong's modulus.

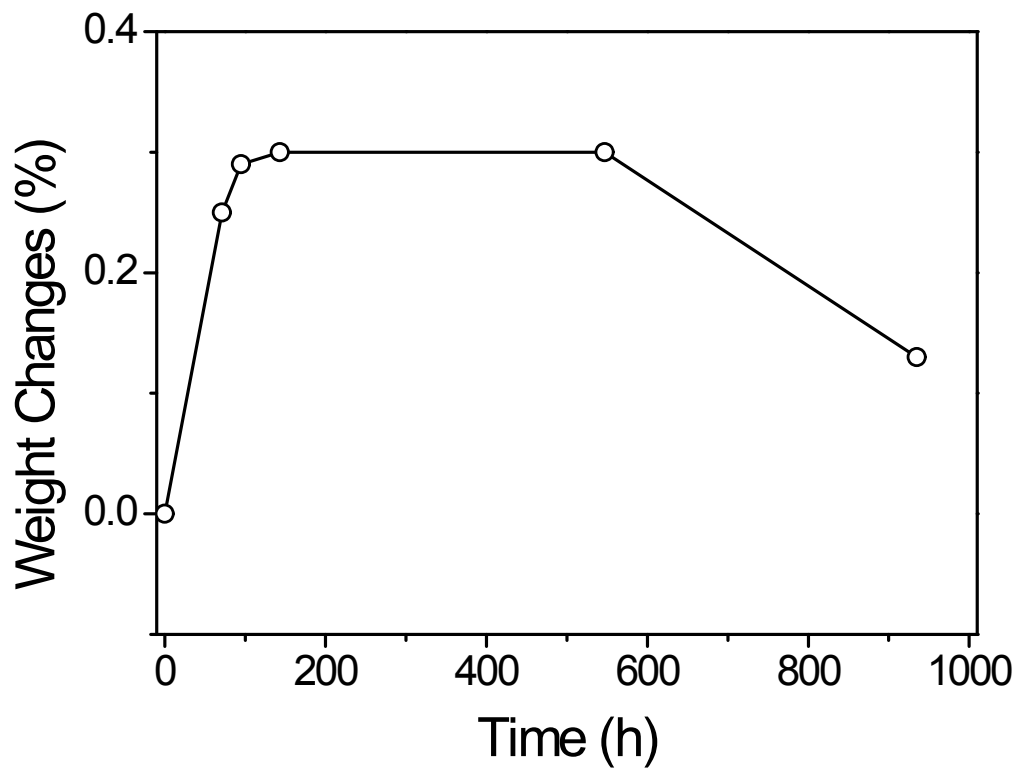


Fig. S5. Corrosion resistance of WPUA coated Zn plate immersed in 10 % hydrochloric acid solution.

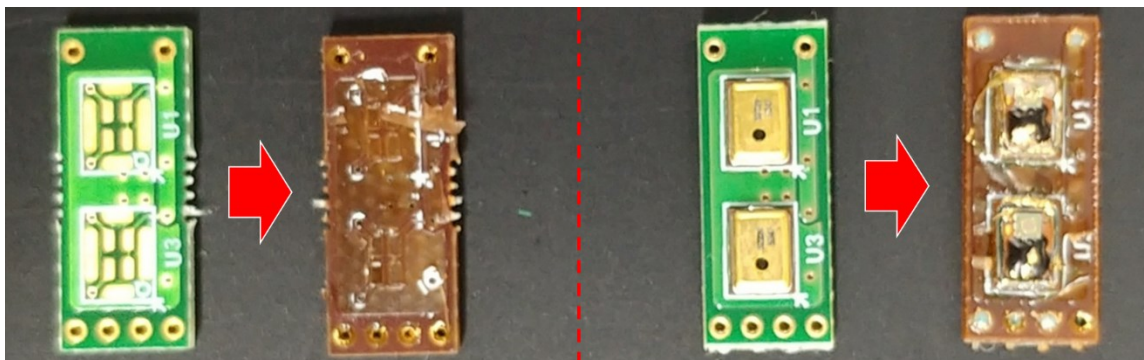
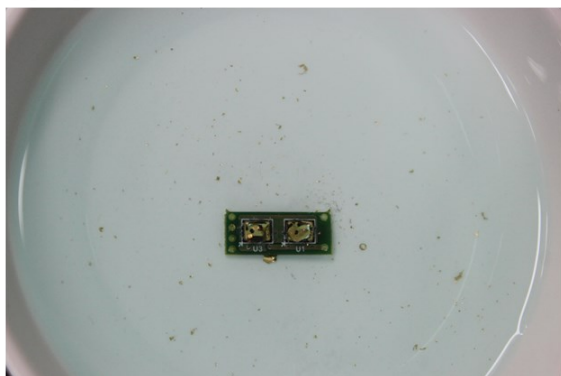


Fig. S6. Before and After photo images of the circuit board containing copper alloys without coating immersed in 65 vol% nitric acid solution after 10 minutes. Backside(left) and frontside(right)

(a)



(b)



Fig. S7. Photo images of non-coating circuit board immersed in 30 vol% nitric acid solution. Fragmented copper alloy spread into the solution after 3 hours (a) and continued after 5 hours (b).