Supplementary Information (SI) for Journal of Materials Chemistry C.

Improving electromagnetic engineering of thermal conductive composites by establishing continuous thermal conductive networks with gradient impedance

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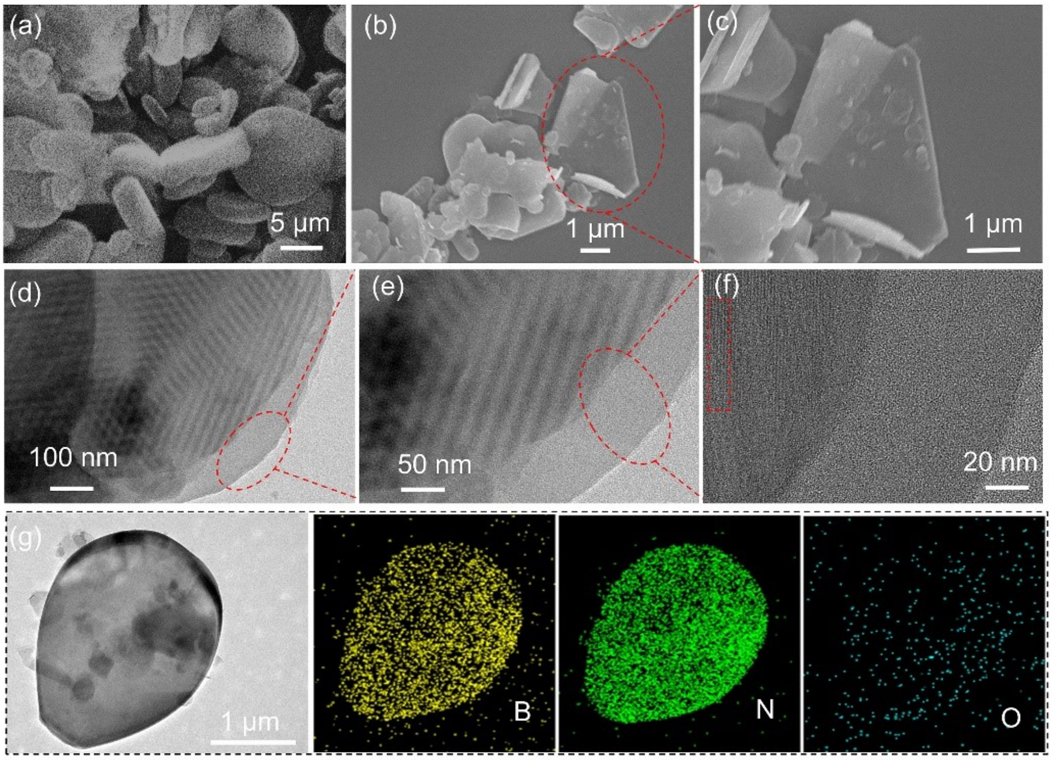

Fig. S1. SEM images of a) h-BN, b-c) few-layer BNNS. d-f) TEM images of few-layer BNNS and g) few-layer BNNS element mapping.

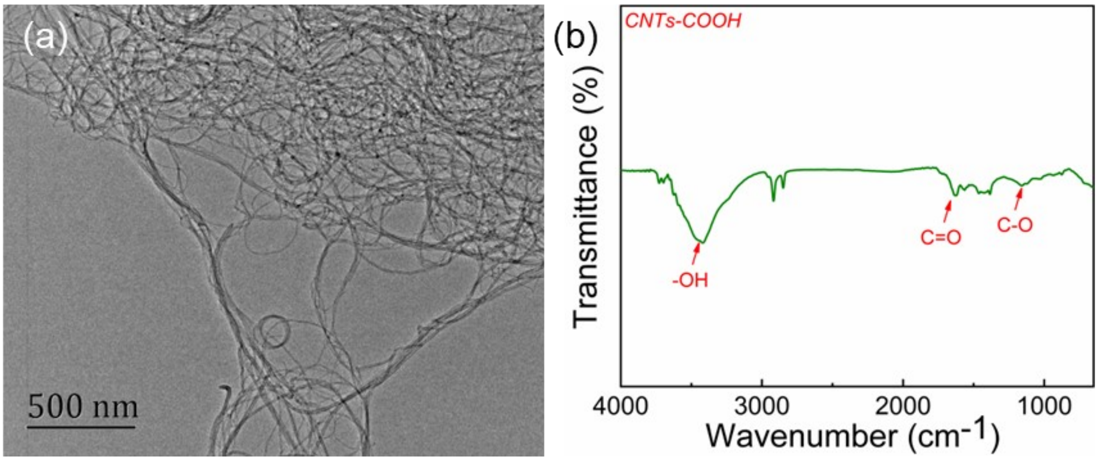

Fig. S2. (a) TEM images of CNTs-COOH, (b) FT-IR spectrum of CNTs-COOH.

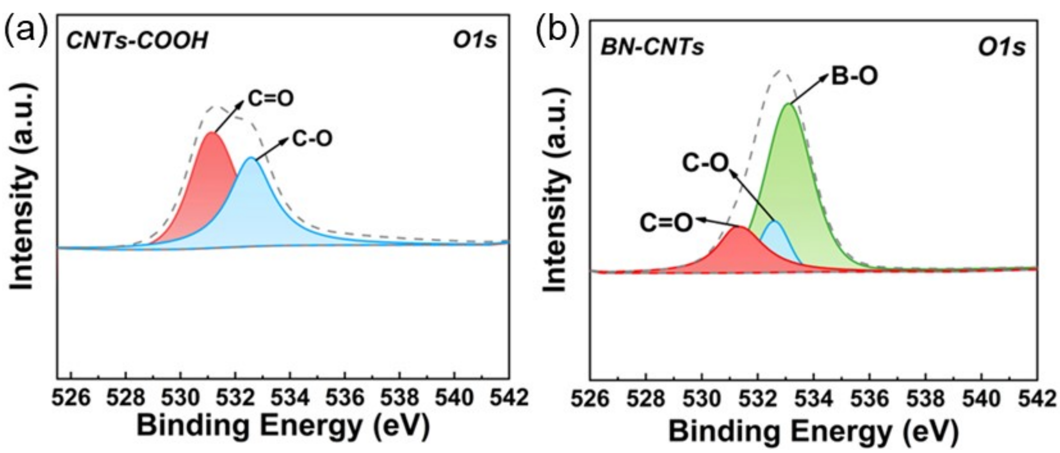

Fig. S3. XPS spectrums of O1s for CNTs-COOH and BN-CNTs hybrids, respectively.

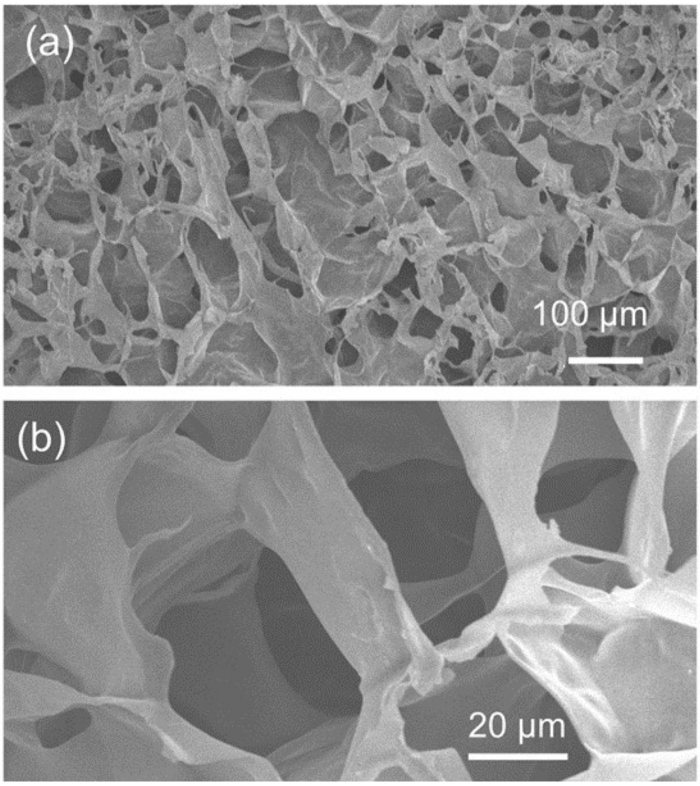

Figure S4. SEM images of CMC aerogel.

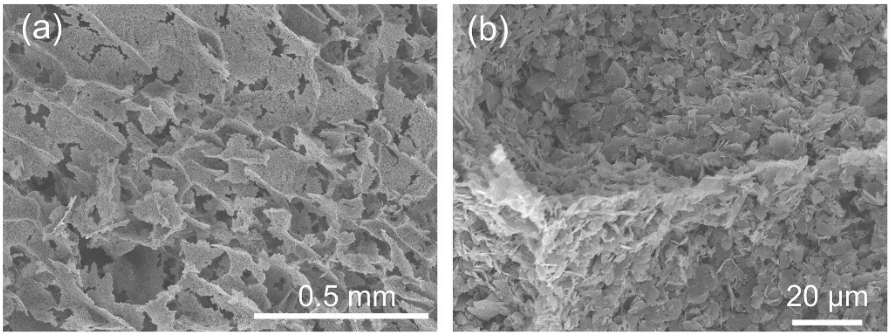

Figure S5. SEM images of CMC/BN aerogel.

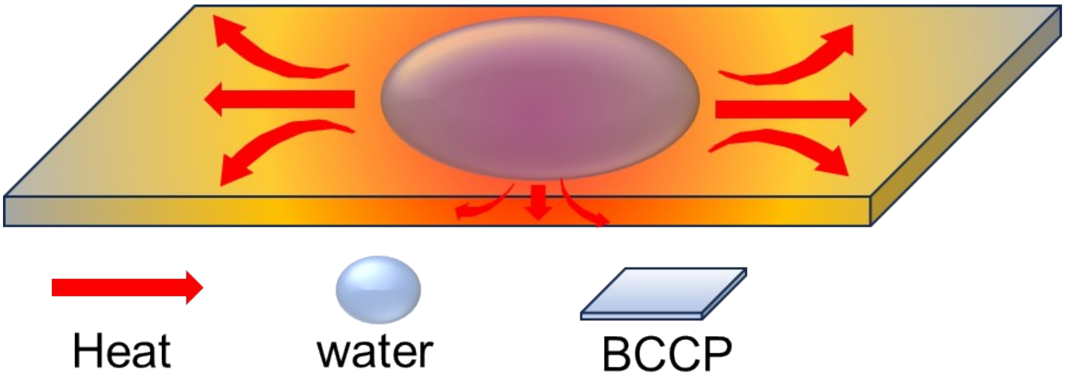

Figure S6. the diagram of heat dissipation of the water with composites.

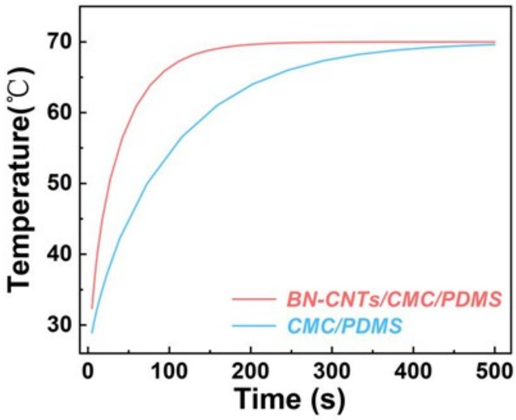

Figure S7. the change of surface temperature with the heating time.

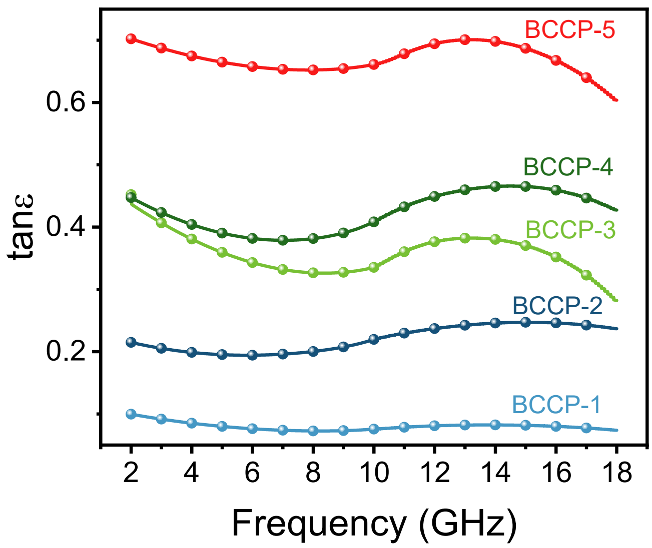

Figure S8. Tan ε of BCCP composites.

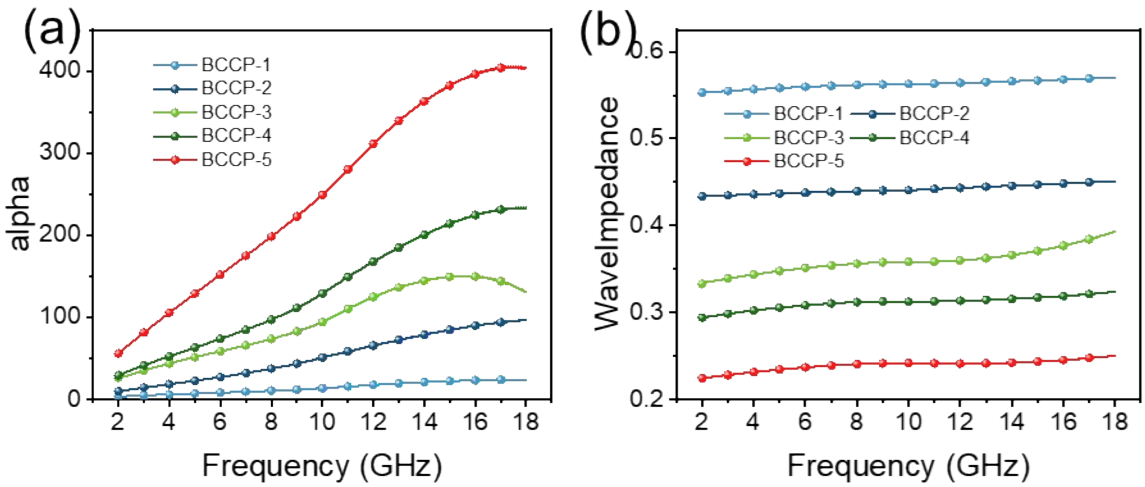

Fig. S9. Alpha and wave impedance of BCCP composites.

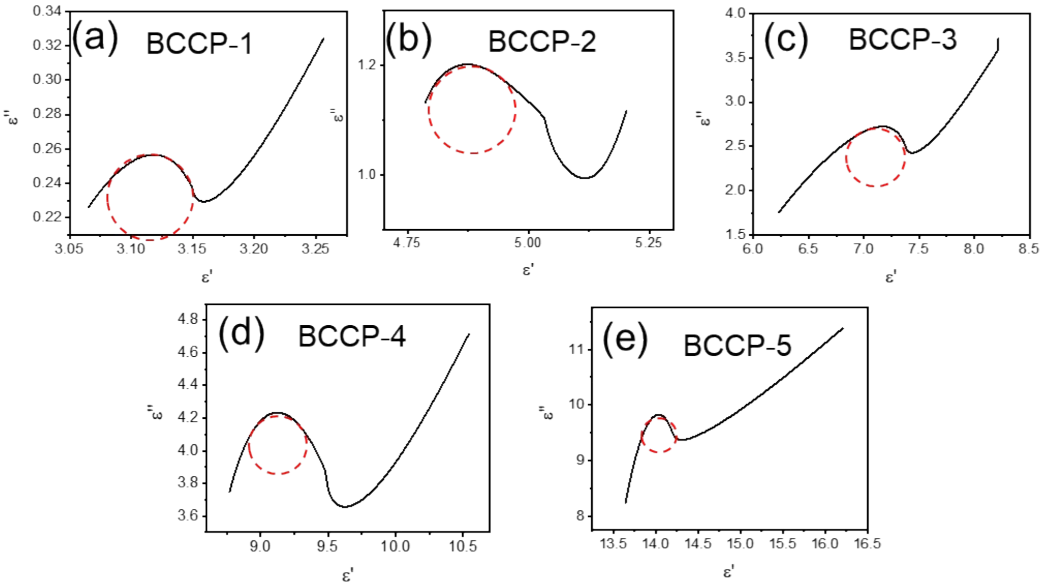

Fig. S10. Typical Cole-Cole semicircles (ε′ versus ε″) of BCCP composites.

Table S1. Thermal conductivity of BCCP composites.

Sample	Thermal conductivity ($W\cdot m^{-1}\cdot K^{-1}$)
BCCP-1	3.56±0.26
BCCP-2	3.87±0.19
BCCP-3	4.26±0.15
BCCP-4	4.78±0.22
BCCP-5	5.07±0.18

Table S2 Comparison of wave absorption and thermal conduction of PCBC composites with those of relevant composites reported in the literature.

Filler	Matrix	Filler proportion (%)	Thermal conductivity ($W \cdot m^{-1} \cdot K^{-1}$)	RL_{min} (dB)	R_L <-10 dB		
					Thickness (mm)	EAB (GHz)	
CNF@C-Ni	Epoxy	5	0.5	-49.77	2.2	5.44	[1]
BN-MXene	PDMS	15	2.03	-49.37	2.0	5.8	[2]
SiC@BN	Epoxy	16.69	2.21	-21.5	3.0	2.8	[3]
BCN@LDH	EP	10	0.49	-55.75	2.1	6.43	[4]
BCN	Natural rubber	2.86	0.338	-54.24	1.4	4.16	[5]
CNF/Fe_xO_y	Wafers	30	3.22	-41.16	3.3	10.72	[6]
SG@SiC	Silicone rubber	73.3	3.28	-31.9	2	2.9	[7]
GN/PPy/Al_2O_3	Silicone rubber	50	4.649	-14.78	2	6.48	[8]
Ni@C	Natural rubber	-	0.2	-54.8	1.9	7.8	[9]
BNNS@Fe_3O_4	-	100	1.75	-45.31	2	2.5	[10]
Ni@GNP	PMMA	30	1.29	-30	2	1.4	[11]
NPC@$MoSe_2$	PDMS	15	0.97	-51.6	2.6	7.1	[12]
MDCF@BN	EP	25	0.99	-52.77	3	5.6	[13]
CNT@NiO	natural rubber	5	1.05	-47.1	1.5	4.24	[14]
Mxene/Co	PVDF	12	1.36	-45.6	4	-	[15]
TiO_2@C–Ni/CNTs	natural rubber	3	0.25	-32.3	1.8	5.5	[16]
BCCP-4	PDMS	8	3.56	-63.34	1.7	4.81	This work

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