

## Electronic supplementary information

### **Polyimide-based graphene composite foams with hierarchical impedance gradient for efficient electromagnetic absorption**

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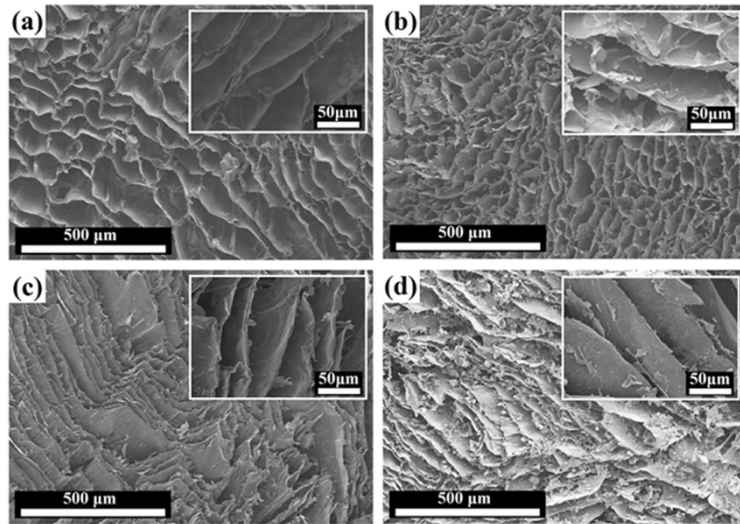
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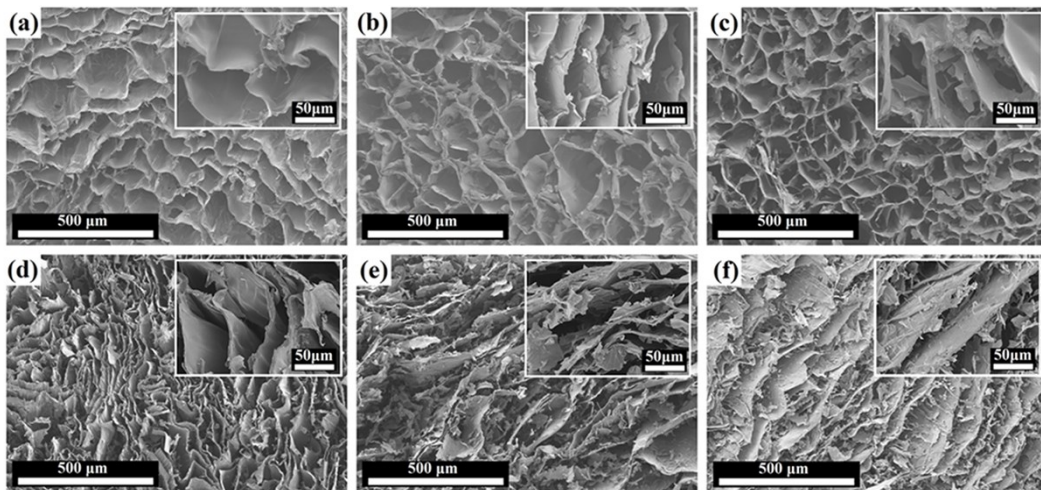
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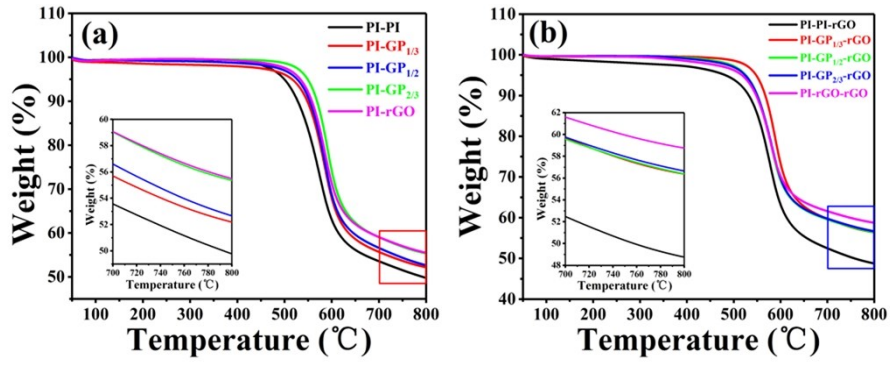
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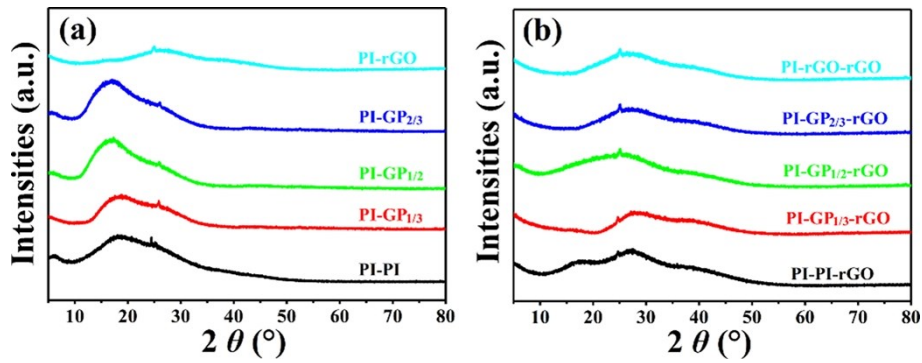
**Fig. S1** SEM images of polyimide-based graphene composite foams: (a) PI-PI; (b) PI-rGO; (c) PI-PI-rGO and (d) PI-rGO-rGO.



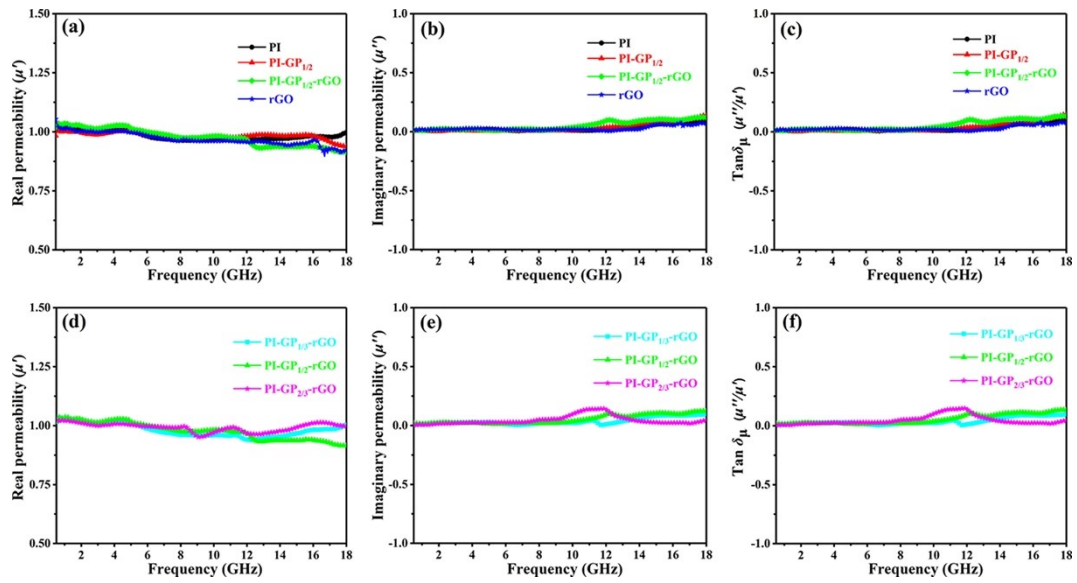
**Fig. S2** SEM images of composite foams loaded with rGO/PI<sub>x</sub> at different concentration ratios: (a) PI-GP<sub>1/3</sub>; (b) PI-GP<sub>1/2</sub>; (c) PI-GP<sub>2/3</sub>; (d) PI-GP<sub>1/3</sub>-rGO; (e) PI-GP<sub>1/2</sub>-rGO and (f) PI-GP<sub>2/3</sub>-rGO.



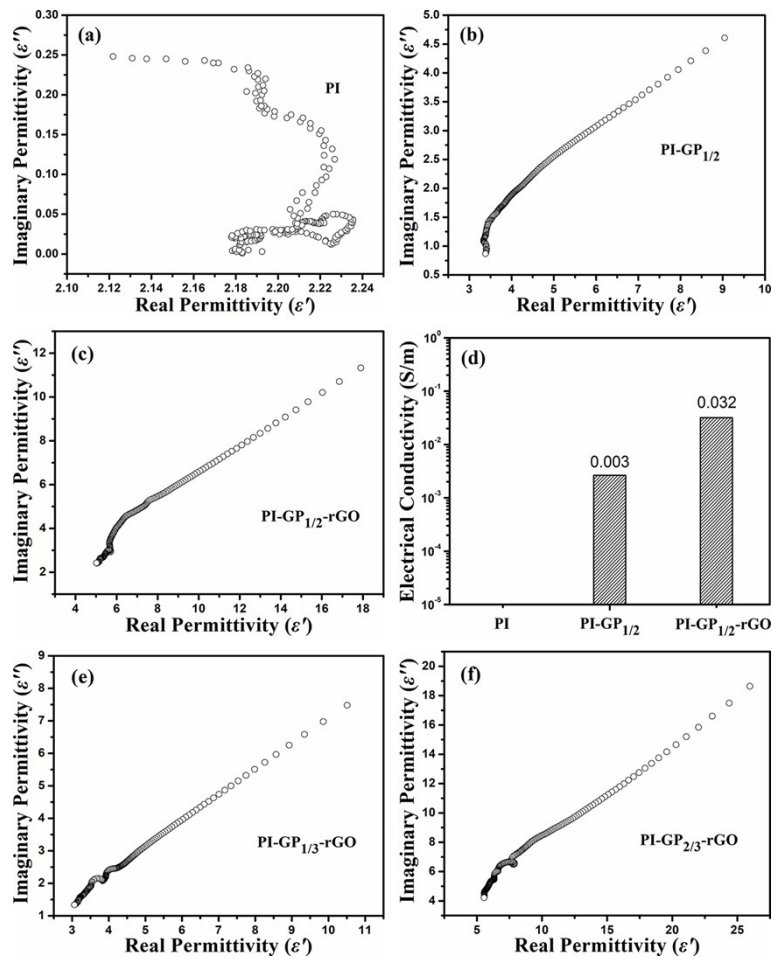
**Fig. S3** TGA curves of (a) bi-layer composite foams: PI-PI, PI-GP<sub>x</sub>, PI-rGO; (b) tri-layer composite foams: PI-PI-rGO, PI-GP<sub>x</sub>-rGO, PI-rGO-rGO ( $x = 1/3, 1/2, 2/3$ ).



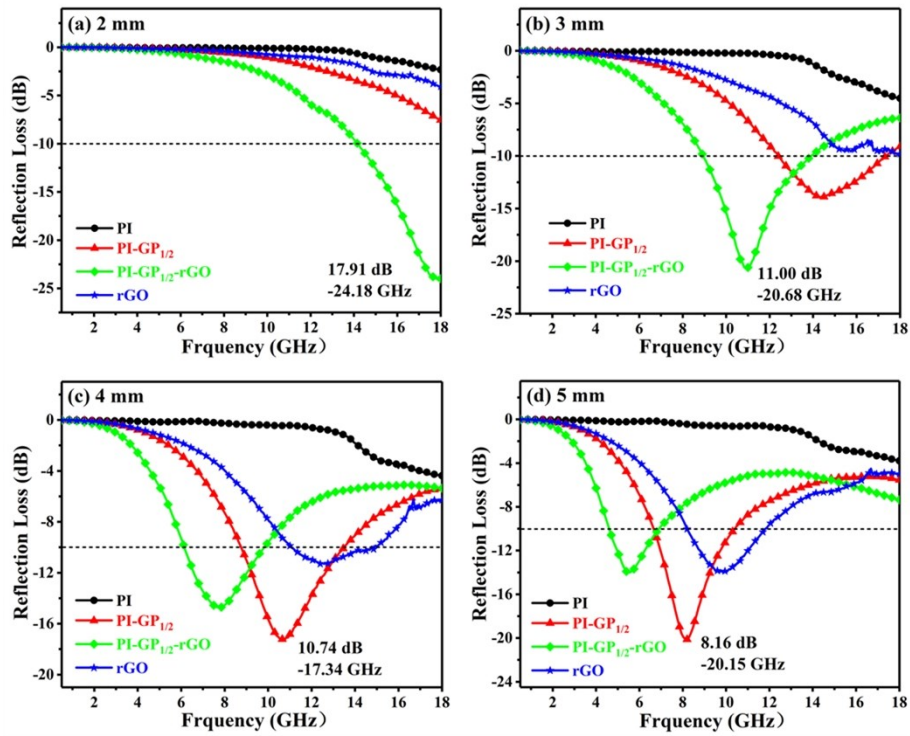
**Fig. S4** XRD curves of (a) bi-layer composite foams: PI-PI, PI-GP<sub>x</sub>, PI-rGO; (b) tri-layer composite foams: PI-PI-rGO, PI-GP<sub>x</sub>-rGO, PI-rGO-rGO ( $x = 1/3, 1/2, 2/3$ ).



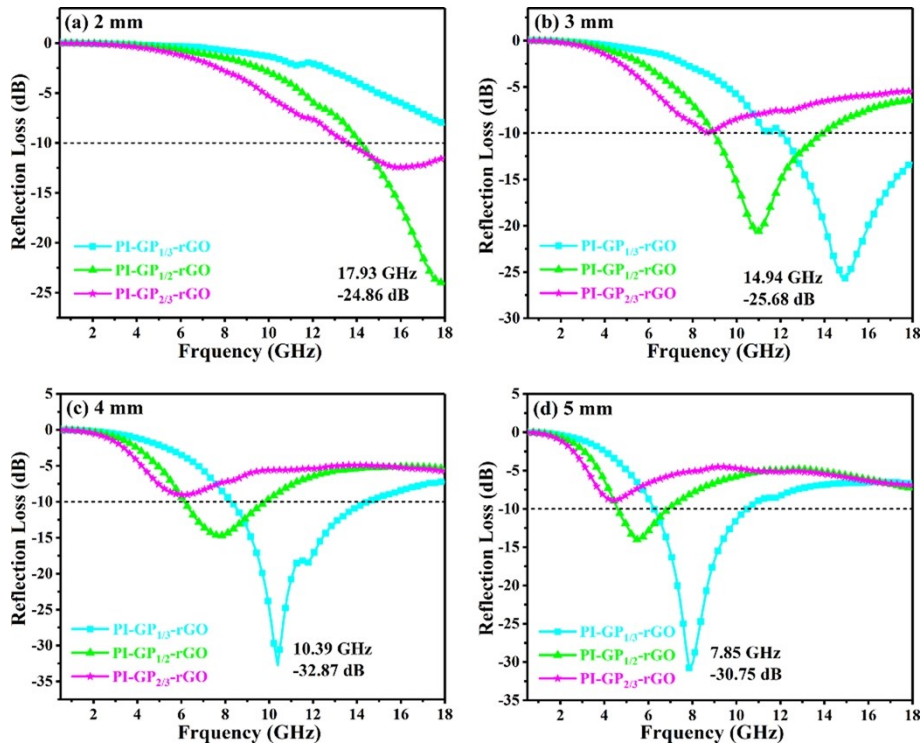
**Fig. S5** The electromagnetic parameters of the composite foams: (a) (d) the real parts of complex permeability; (b) (e) the imaginary parts of complex permeability; (c) (f) permeability tangent of the composite foams.



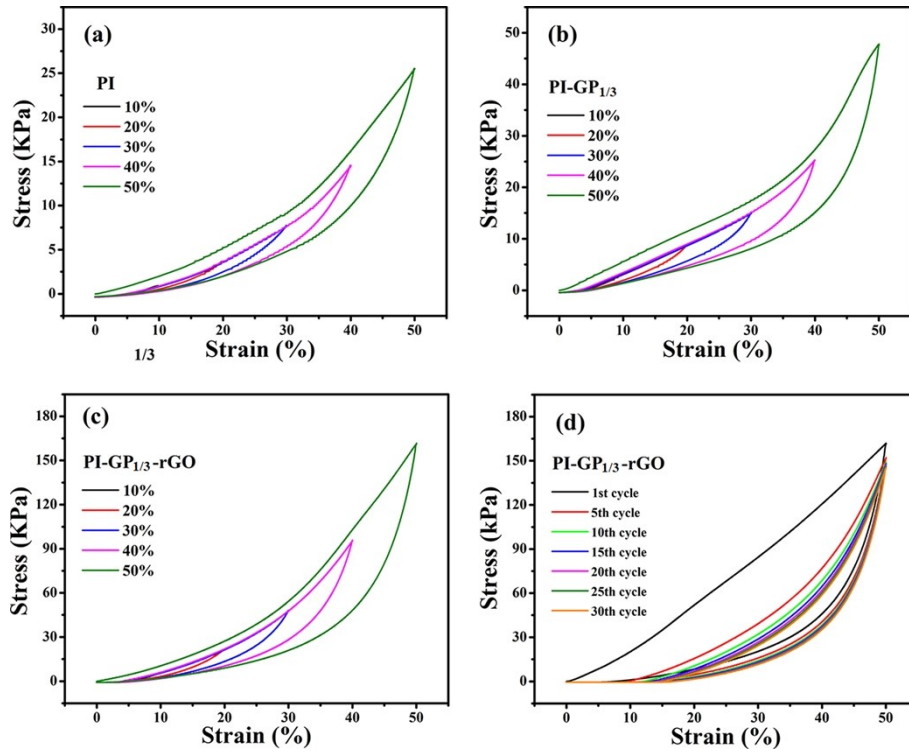
**Fig. S6** The Cole-Cole semicircle curves (a: PI; b: PI-GP<sub>1/2</sub>; c: PI-GP<sub>1/2</sub>-rGO; e: PI-GP<sub>1/3</sub>-rGO; f: PI-GP<sub>2/3</sub>-rGO) and (d) electrical conductivity of polyimide-based graphene composite foams with different hierarchical structures.



**Fig. S7** Reflection loss of PI, PI-GP<sub>1/2</sub>, PI-GP<sub>1/2</sub>-rGO and rGO at different thicknesses: (a) 2 mm; (b) 3 mm; (c) 4 mm; (d) 5 mm.



**Fig. S8** Reflection loss of PI-GP<sub>1/3</sub>-rGO, PI-GP<sub>1/2</sub>-rGO and PI-GP<sub>2/3</sub>-rGO at different thicknesses: (a) 2 mm; (b) 3 mm; (c) 4 mm; (d) 5 mm.



**Fig S9.** Compressive stress-strain curve (a: PI; b: PI-GP<sub>1/3</sub>; c: PI-GP<sub>1/3</sub>-rGO) and compressive cyclic test (d) of polyimide-based graphene composite foams with different hierarchical structures.