

Supporting Information

Firefly-inspired smart aerogel-based phase-change composite for intelligent microwave absorption

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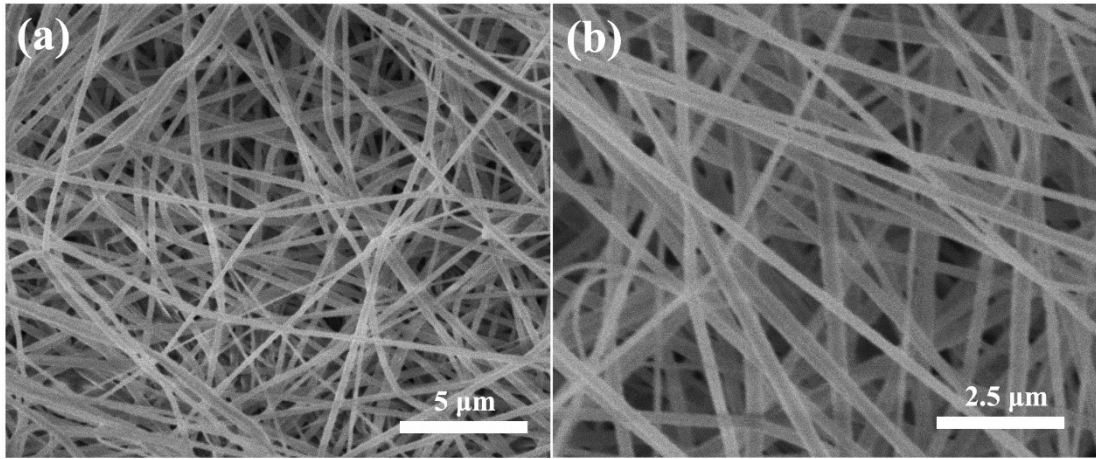


Fig. S1. SEM images of PAN/PVP nanofiber (a, b).

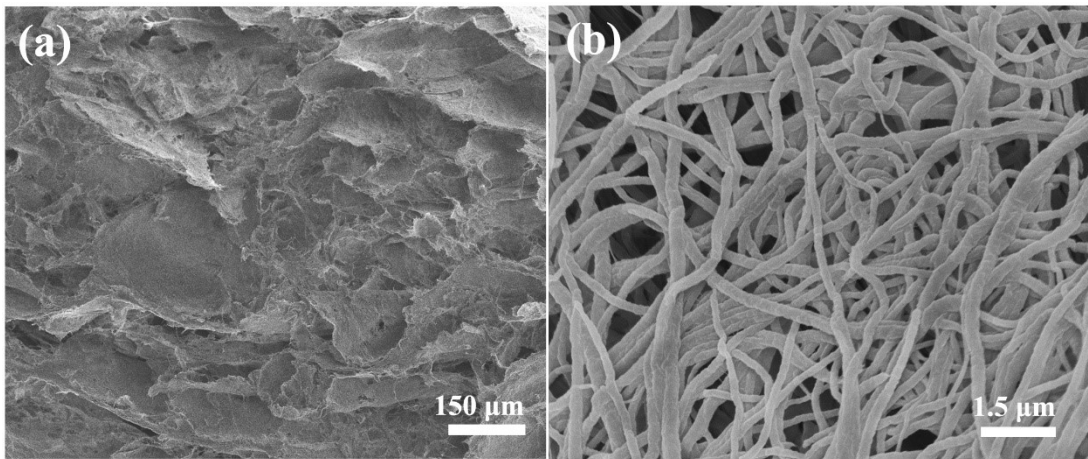


Fig. S2. SEM images of 2P (a, b).

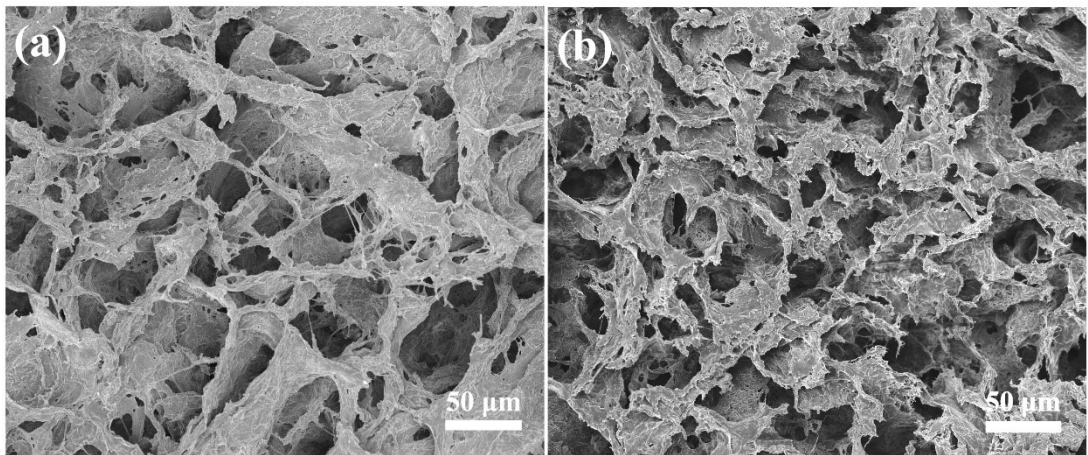


Fig. S3. SEM images of 3P (a, b).

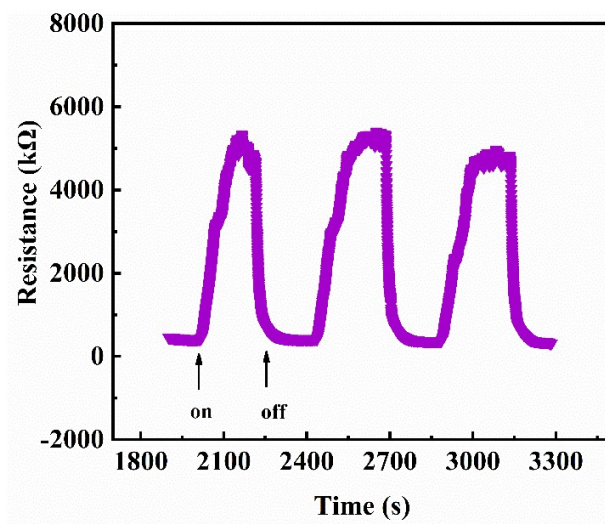


Fig. S4. Time-resistance curve of 3PC/PEG.

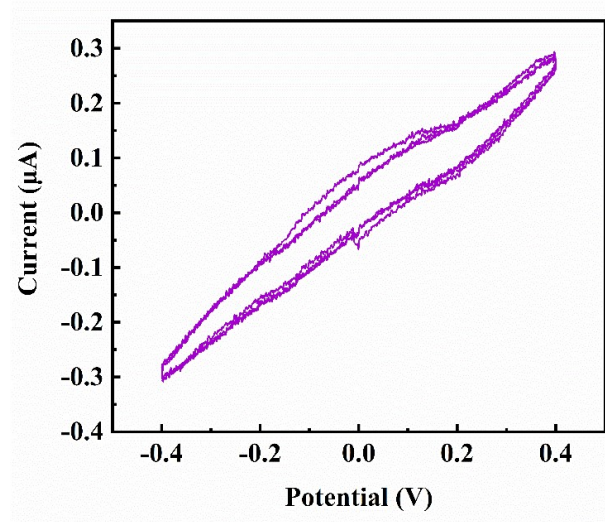


Fig. S5. CV curve of 3PC/mPEG.

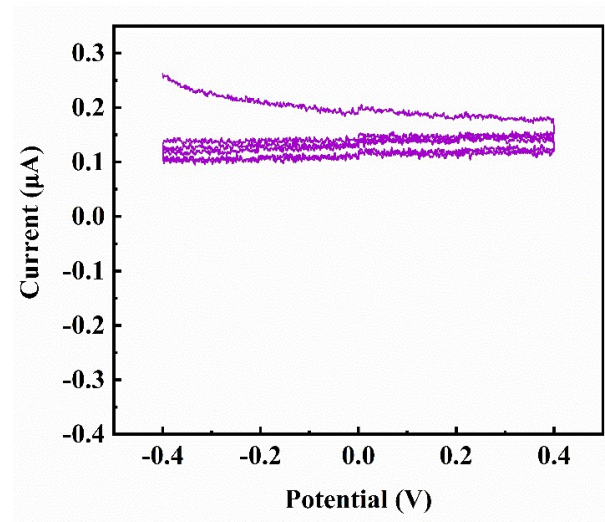


Fig. S6. CV curve of 3PC/cPEG.

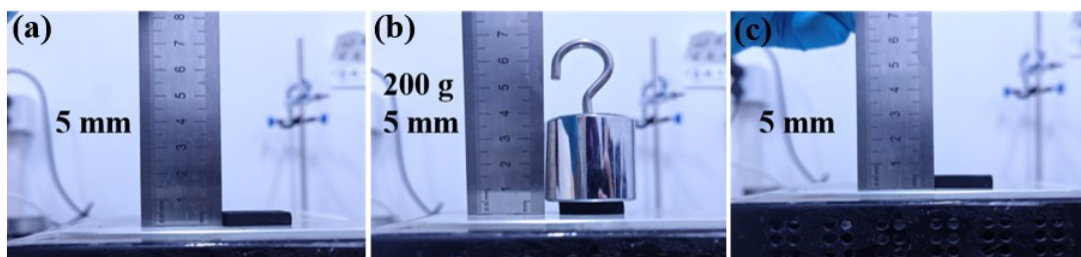


Fig. S7. Optical images of 3PC/PEG loaded with 200 g weight on a 45 °C hot stage (a-c).

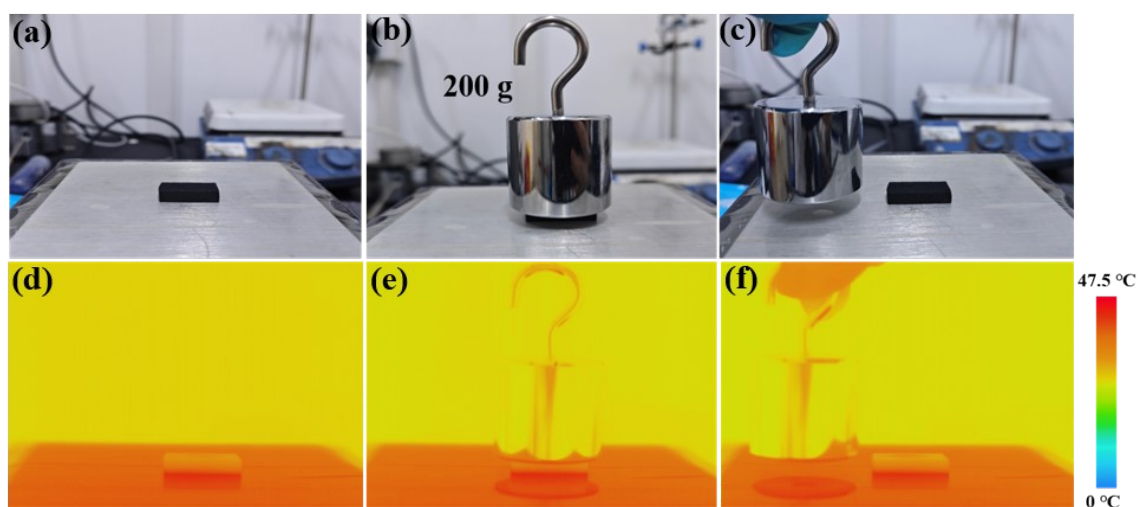


Fig. S8. Thickness change images (a-c) and infrared thermal imaging images (d-f) of 3PC/PEG before and after loading a weight of 200 g on a 45 °C hot stage.

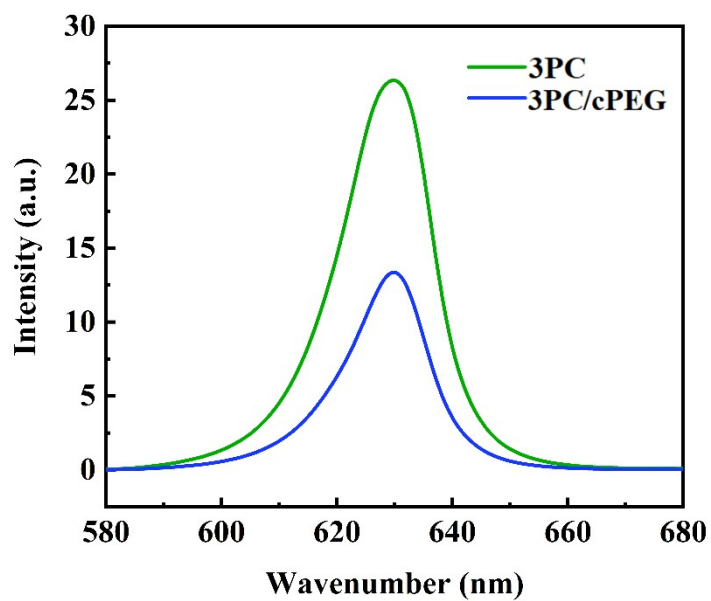


Fig. S9. PL spectra of 3PC and 3PC/cPEG.

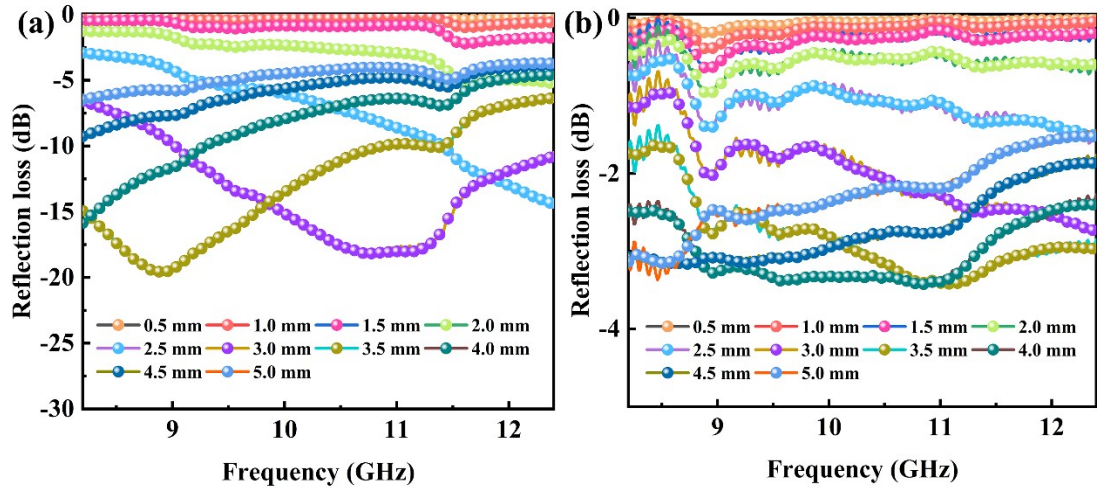


Fig. S10. Reflection loss maps for 3PC/mPEG2000, and 3PC/cPEG2000.

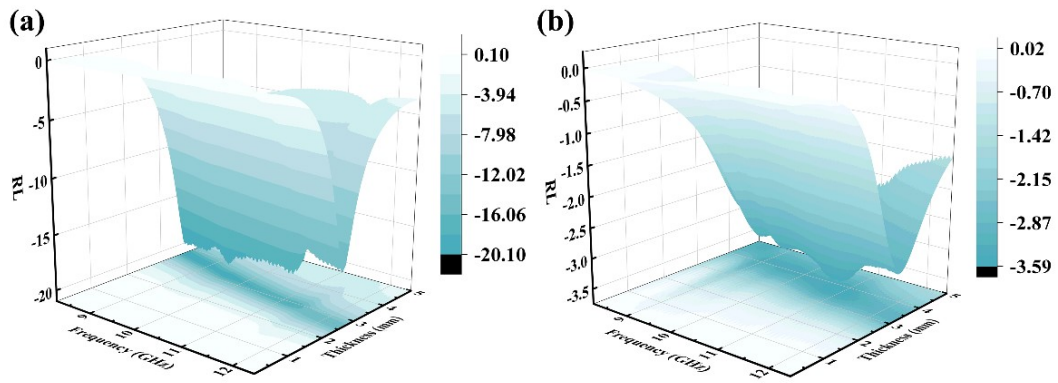


Fig. S11. 3D reflection loss maps for 3PC/mPEG2000, and 3PC/cPEG2000.

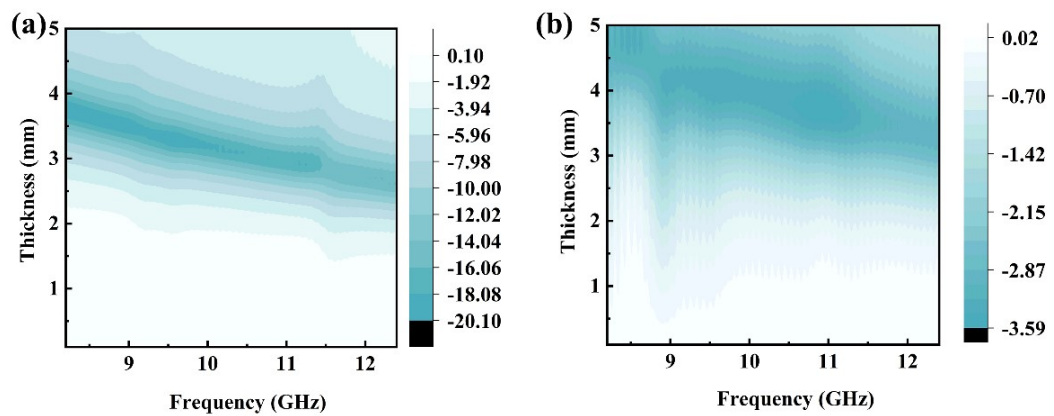


Fig. S12. 2D reflection loss maps for 3PC/mPEG2000, and 3PC/cPEG2000.

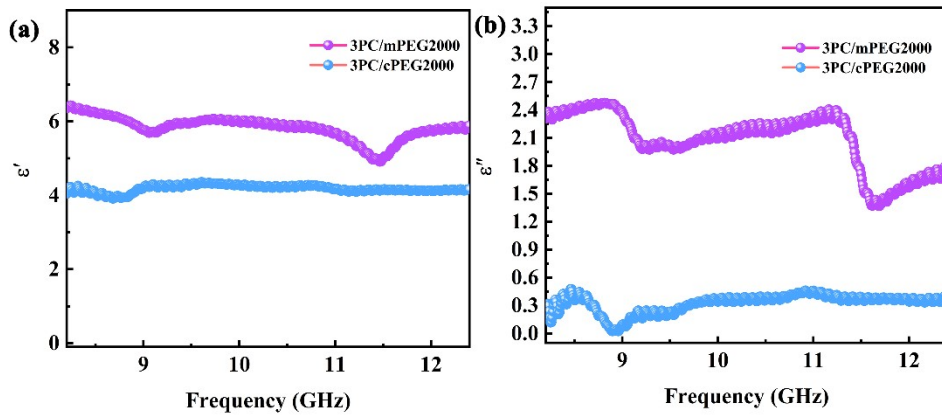


Fig. S13. The dielectric constant real part (a), dielectric constant imaginary part (b) for 3PC/mPEG2000, and 3PC/cPEG2000.

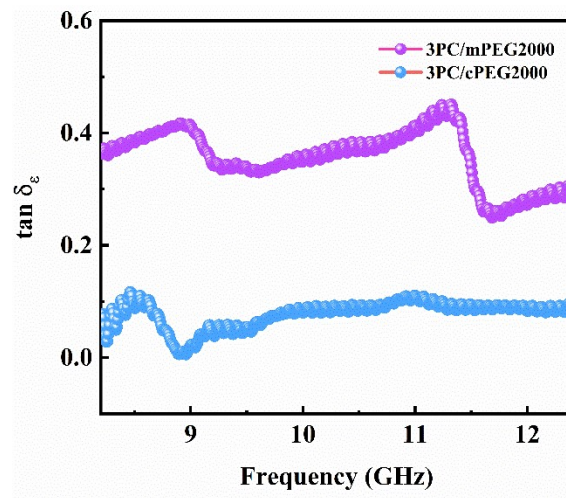


Fig. S14. Dielectric loss tangent for 3PC/mPEG2000, and 3PC/cPEG2000.

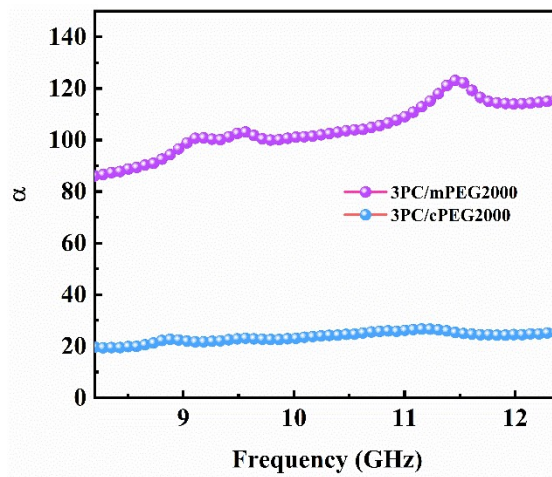


Fig. S15. Attenuation coefficient for 3PC/mPEG2000, and 3PC/cPEG2000.

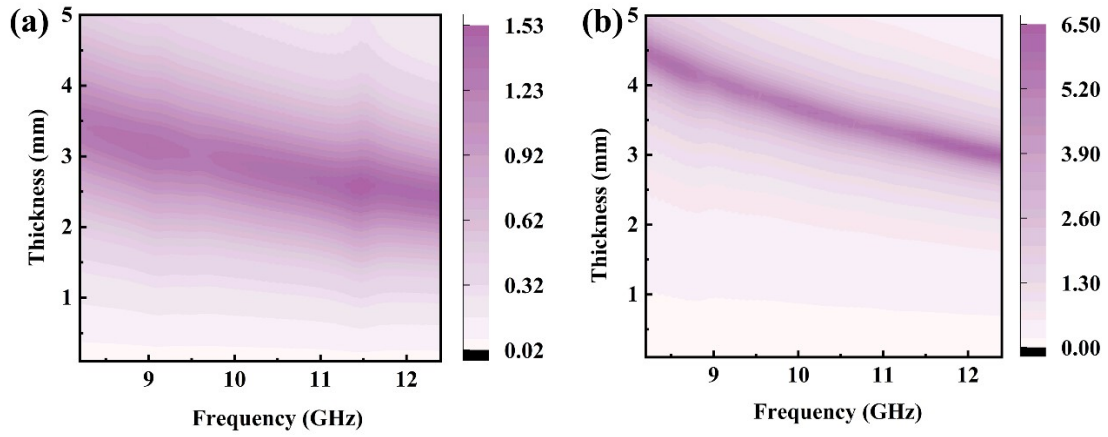


Fig. S16. Impedance matching diagrams for 3PC/mPEG2000, and 3PC/cPEG2000.

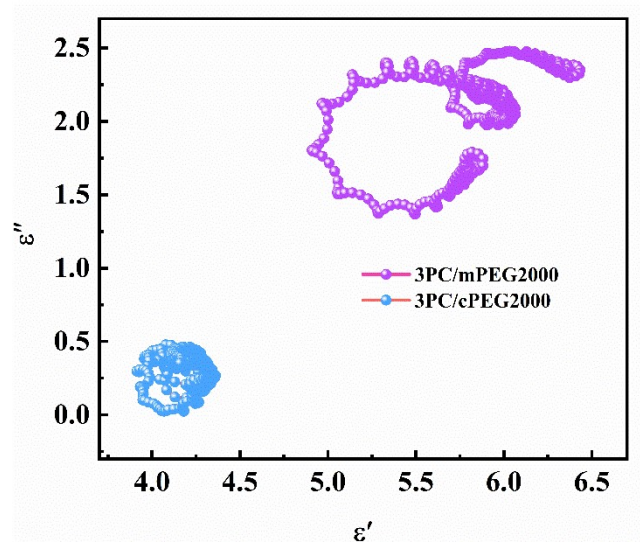


Fig. S17. Cole-Cole curves for 3PC/mPEG2000, and 3PC/cPEG2000.

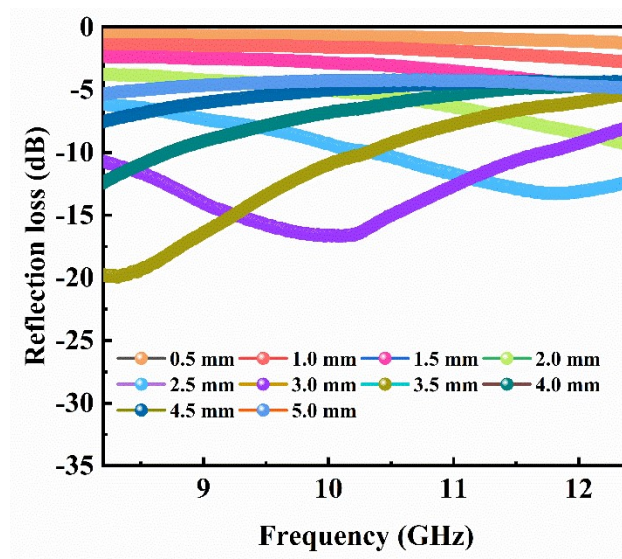


Fig. S18. Reflection loss curves of 3PC/mPEG at different thicknesses after 50 melting-solidification cycles.

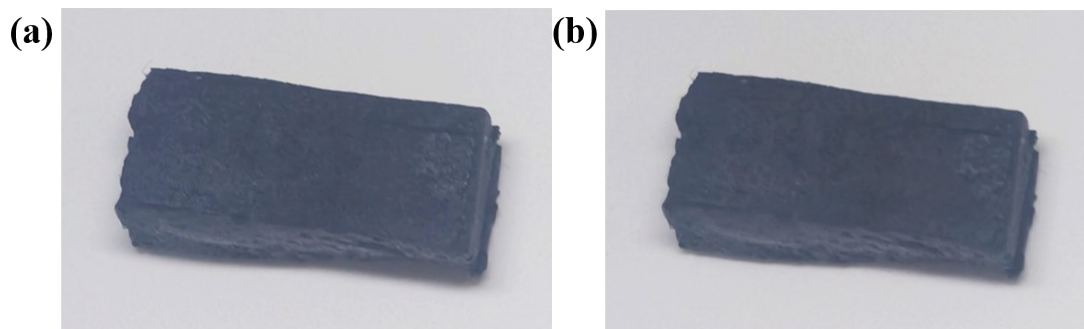


Fig. S19. Digital images of 3PC/mPEG on filter paper before (a) and after (b) melting-solidification cycles.

The scattering parameters (S11 and S21) were obtained using the waveguide method. The EMI SE (SE_T) of the specimen was calculated based on our previous published work[1].

Based on the transmission line theory of 8-12 GHz, the electromagnetic parameters of the sample were recorded.

the RL is evaluated using the following equations:

$$RL = 20 \times \log \left| \frac{Z_{in} - Z_0}{Z_{in} + Z_0} \right| \quad (1)$$

The calculation formulas for the attenuation constant (α) and impedance matching (Z) characteristics are as follows:

$$Z = \frac{Z_{in}}{Z_0} = \sqrt{\frac{\mu_r}{\epsilon_r}} \times \tanh \times [2\pi f d j / c \times \sqrt{\mu_r \epsilon_r}] \quad (2)$$

$$\alpha = \frac{\sqrt{2\pi f}}{c} \times \sqrt{(\mu'' \epsilon'' - \mu' \epsilon') - \sqrt{(\mu'' \epsilon'' - \mu' \epsilon')^2 + (\mu' \epsilon'' - \mu'' \epsilon')^2}} \quad (3)$$

Z_{in} and Z_0 represent the input impedance and the impedance of free space, respectively. ϵ_r and μ_r represent the complex permittivity and complex permeability. ϵ' , ϵ'' , μ' , μ'' correspond to the real and imaginary parts of the dielectric constant and the real and imaginary parts of the permeability, respectively. Where d , c and f are the matching thickness, the speed of light in vacuum and the microwave frequency respectively.

References

- [1] J. Shi, J. Tian, Y. Xu, F. Huang, Q. Wei, Y. Cai, *J. Mater. Chem. A*, 2025, **13**, 24028-24037.