

Supporting Information

Design integration of hollow structures in graphene aerogel for multifunctional electromagnetic wave absorption applications

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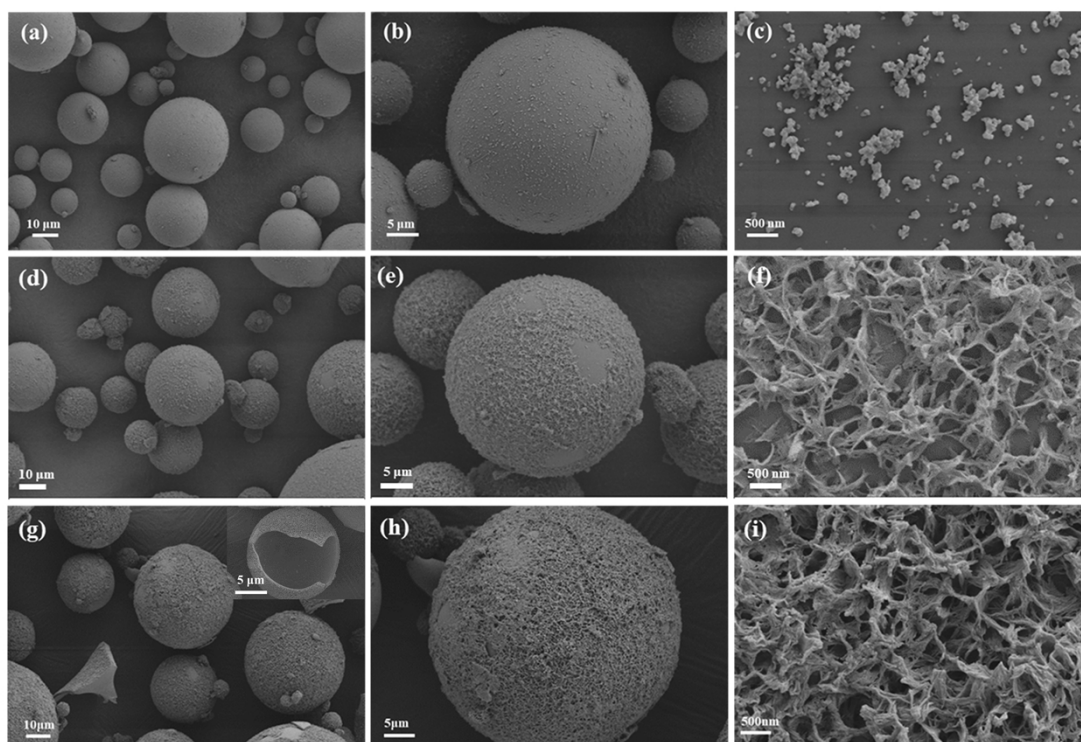


Figure S1. SEM images of HGMs (a-c), hydroxylated HGMs (d-f), aminated HGMs (g-i).

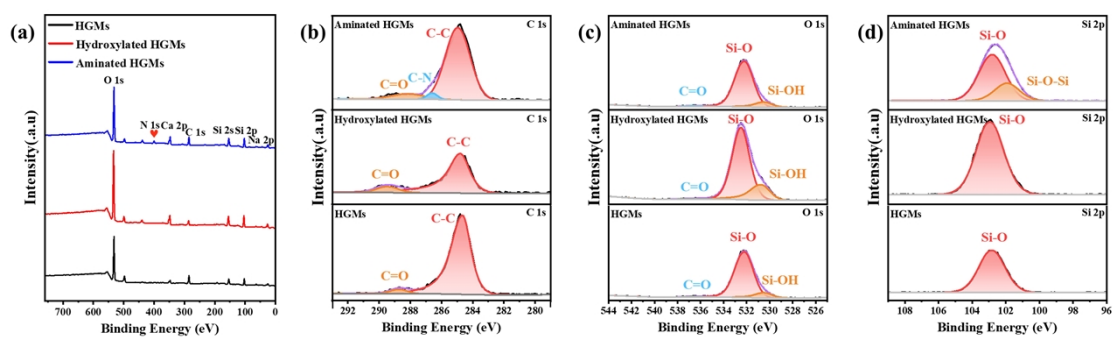


Figure S2. XPS full spectra (a), C 1s XPS spectra (b), O 1s XPS spectra (c) and Si 2p XPS spectra (d) of HGMs, hydroxylated HGMs, and aminated HGMs.

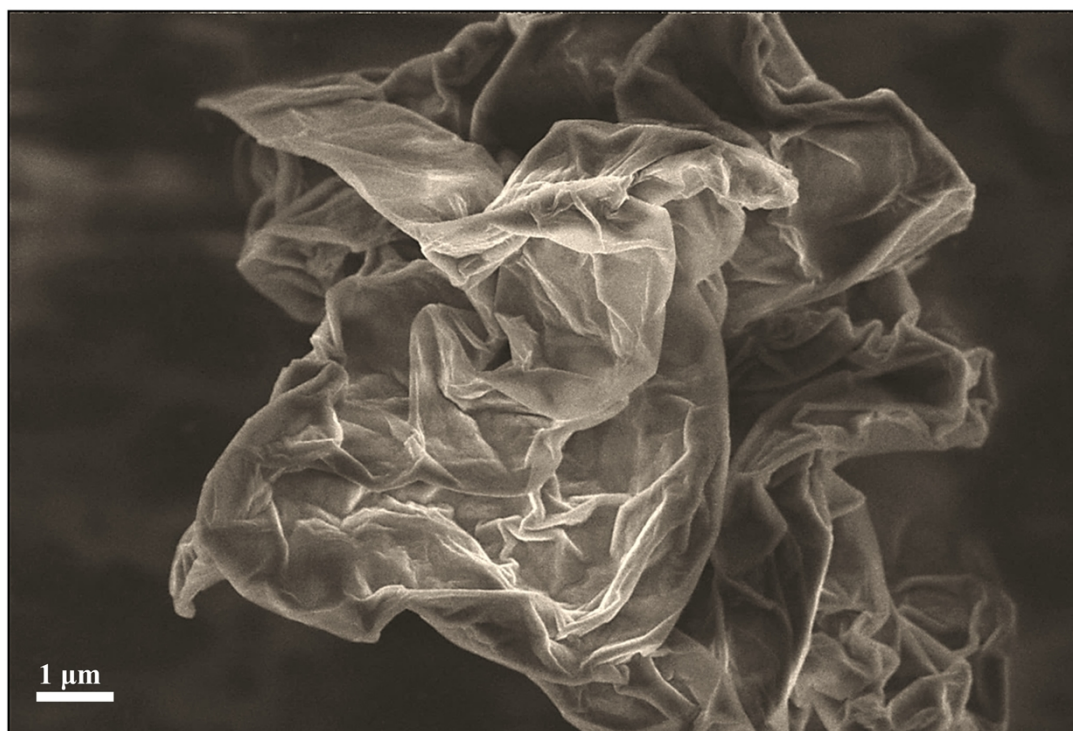


Figure S3. SEM image of GO.

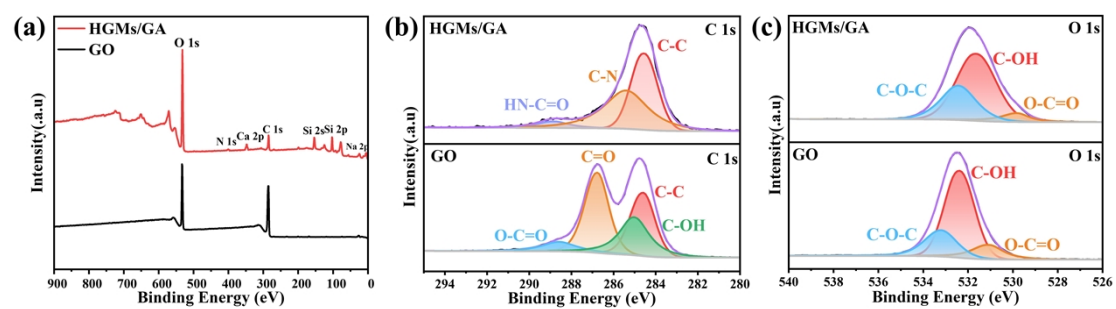


Figure S4. XPS full spectra of (a), C 1s XPS spectra (b), O 1s (c) spectra of GO and HGMs/GA.

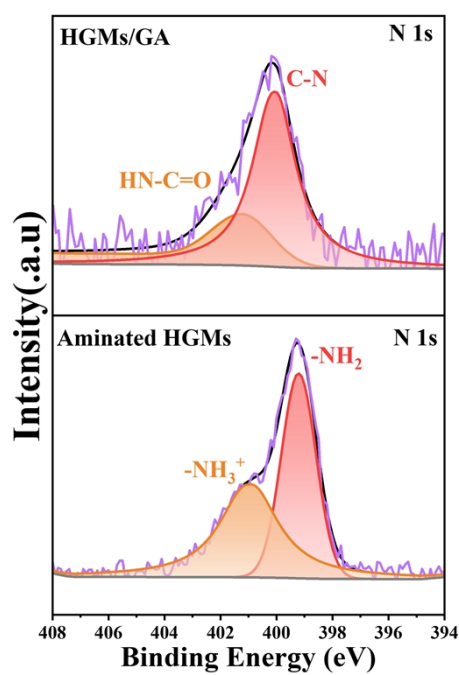


Figure S5. N 1s XPS spectrum of aminated HGMs and HGMs/GA.

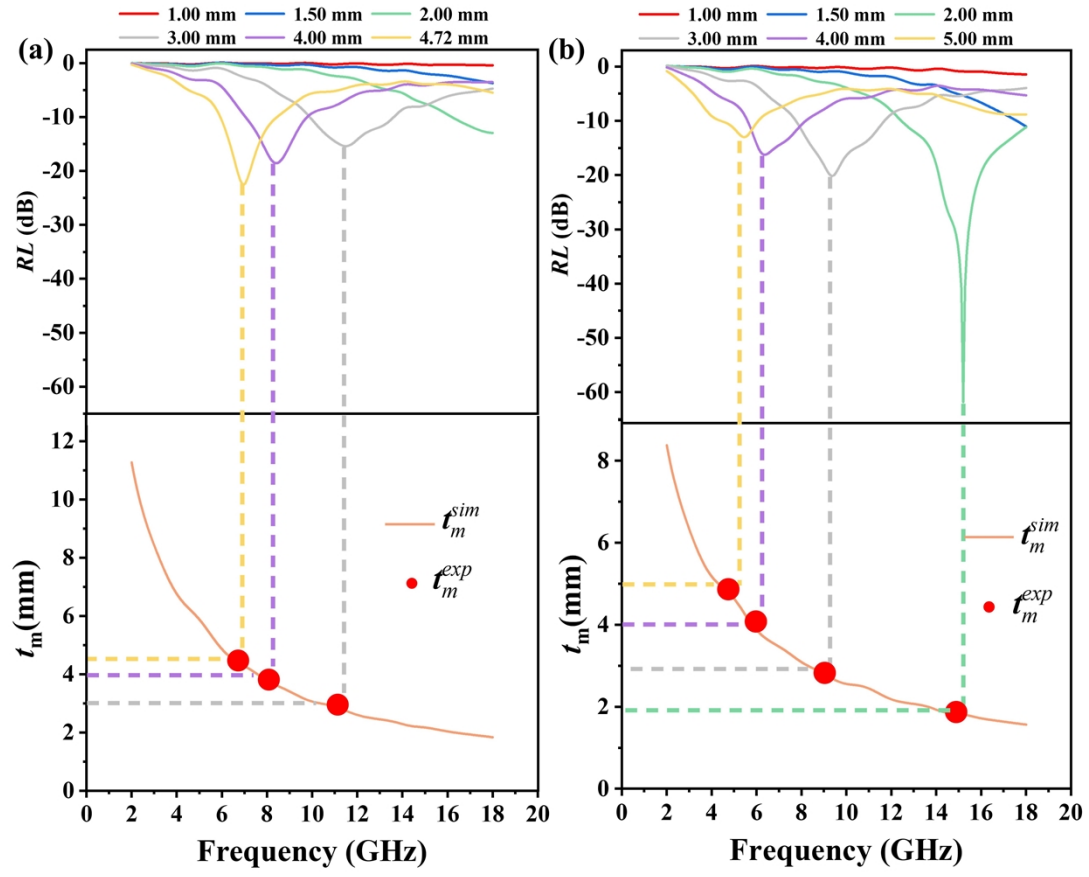


Figure S6. RL values and simulations of the t_m versus f_m under the $\lambda/4$ matching thickness of GA (a) and HGMs/GA (b).

Table S1. EMW absorption performance of some carbon graphene-based EMW absorbing materials in previous reports and this work.

Samples	Minimum <i>RL</i> (Frequency, thickness)	<i>EAB</i> (<i>RL</i> <-10 dB) (Bandwidth, thickness)	Ref.
Ni-Co PBA/graphene aerogel	-62.3 dB (13.3 GHz, 2.3 mm)	5.6 GHz (12.4-18.0 GHz), 2.1 mm	[1]
NiAl-layered double hydroxide/graphene	-41.5 dB (17.8 GHz, 1.4 mm)	4.4 GHz (13.4-17.8 GHz), 1.6 mm	[2]
Fe ₃ O ₄ -C/reduced graphene oxide	-60.5 dB (4.8 GHz, 3.6 mm)	5.5 GHz (11.2-16.7 GHz), 1.5 mm	[3]
Ceramic-confined graphene aerogel	-57.9 dB (4.9 GHz, 4.8 mm)	5.0 GHz (13.0-18.0 GHz), 1.7 mm	[4]
Ni/Carbon nanotube/graphene	-45.5 dB (6.2 GHz, 5.0 mm)	5.6 GHz (11.9-17.5 GHz), 2.5 mm	[5]
Mesoporous barium ferrite/nitrogen-doped graphene	-62.3.0dB (7.5 GHz, 2.6mm)	4.2 GHz (13.8-18.0 GHz), 1.4mm	[6]
Nitrogen-doped reduced graphene oxide/CeO ₂	-50.0 dB (12.7 GHz, 6.5mm)	5.7 GHz (12.3-18.0 GHz), 1.9 mm	[7]
Co/N-doped graphene/carbon nanotubes	-65.5 dB (17.5 GHz, 1.5 mm)	4.3 GHz (10.5-14.8 GHz), 2.0 mm	[8]
HGMs/GA	-61.8 dB (15.2 GHz, 2.0 mm)	5.8 GHz (12.2-18.0 GHz), 1.9 mm	This Work

References:

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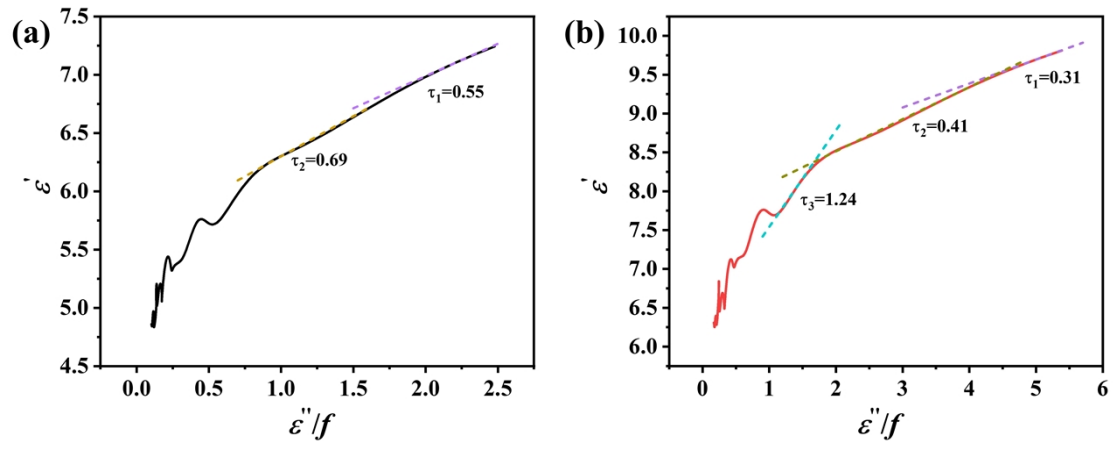


Figure S7. The corresponding relationships between ε' and ε''/f of GA (a) and HGMs/GA (b).

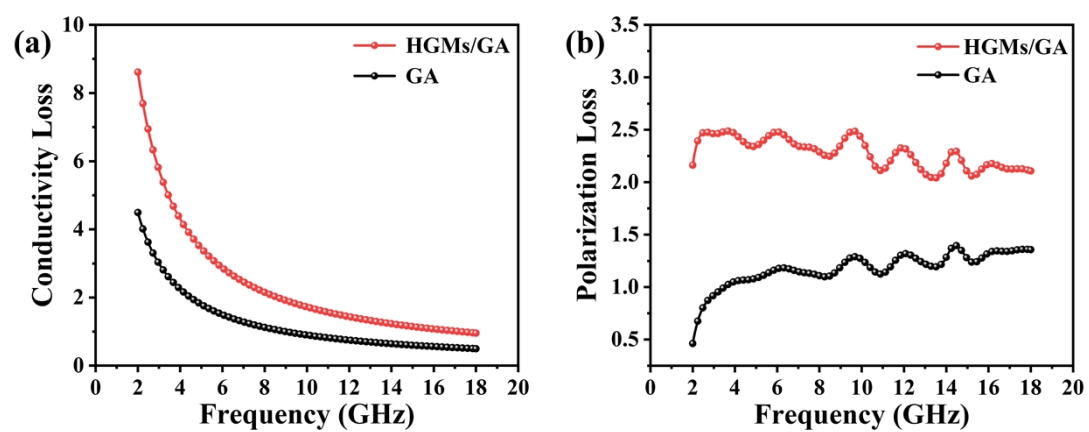


Figure S8 Conductivity loss (a) and polarization loss (b) of GA and HGMs/GA.

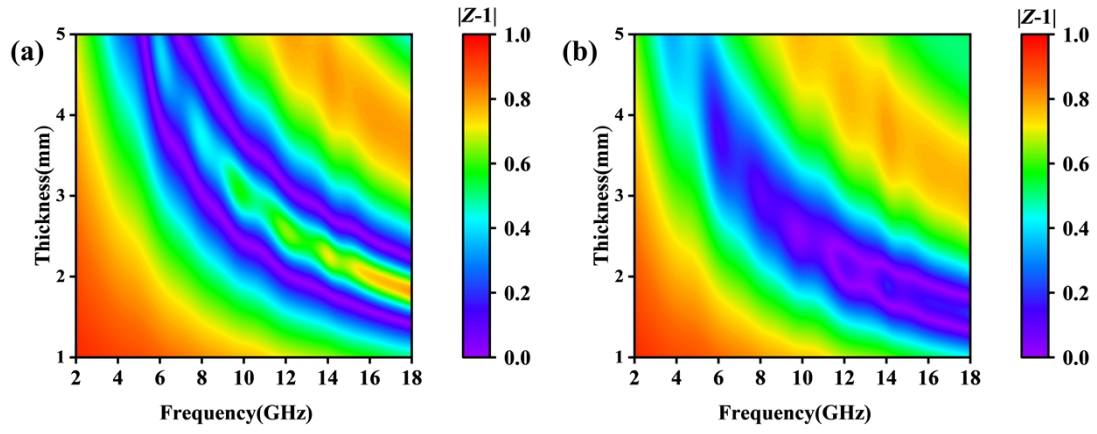


Figure S9. The $|Z-1|$ values of GA (a) and HGMS/GA (b).

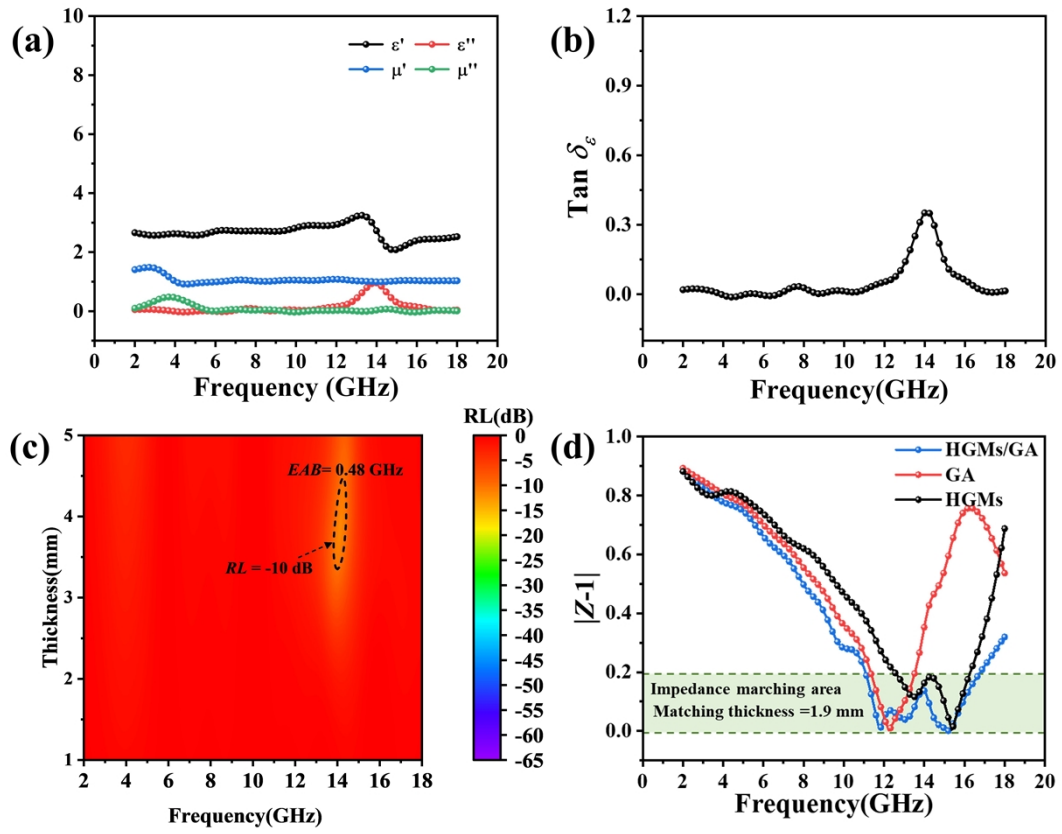


Figure S10. Electromagnetic parameters (a), dielectric loss tangents (b), 2D RL plot (c) of HGMs. $|Z-1|$ values (d) of HGMs, GA, and HGMs/GA at a matching thickness of 1.9 mm.

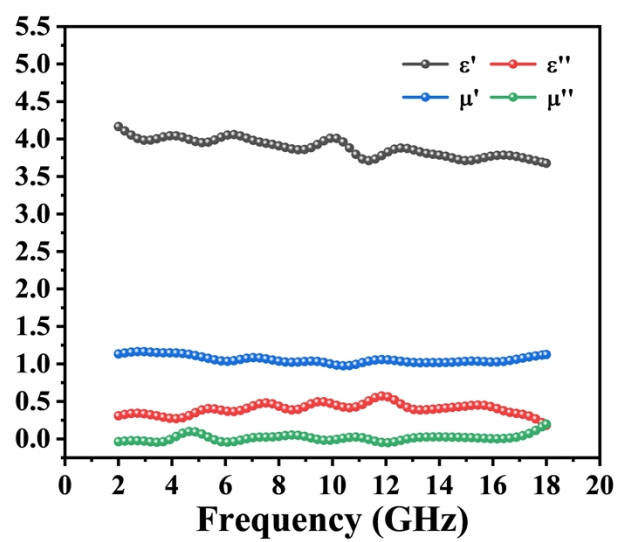


Figure S11. Electromagnetic parameters of HGMS/rGO.

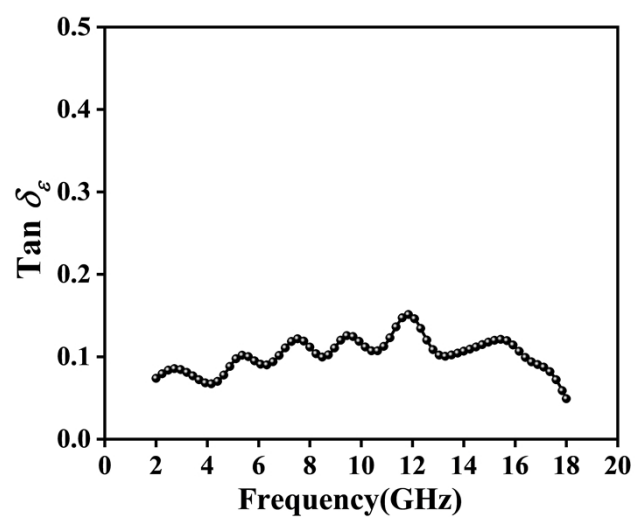


Figure S12. Dielectric loss tangents of HGMs/rGO.

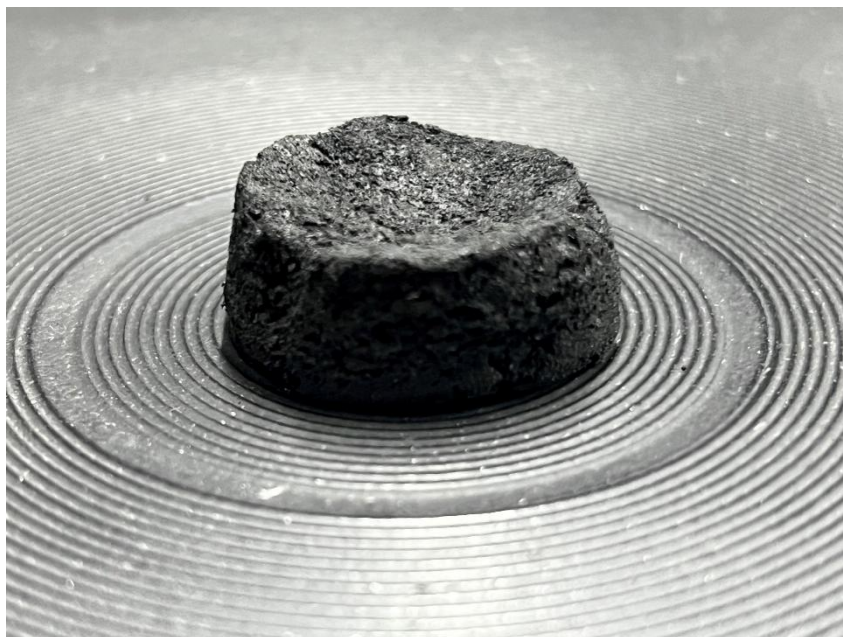


Figure S13. The photo of HGMs/GA placed on a heating stage.

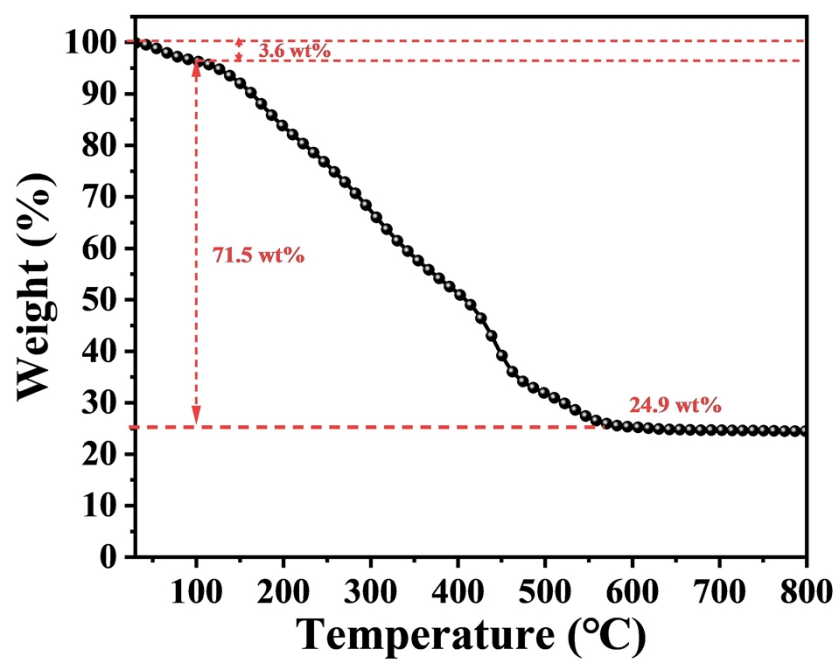


Figure S14 Thermogravimetric analysis of HGMs/GA in air.

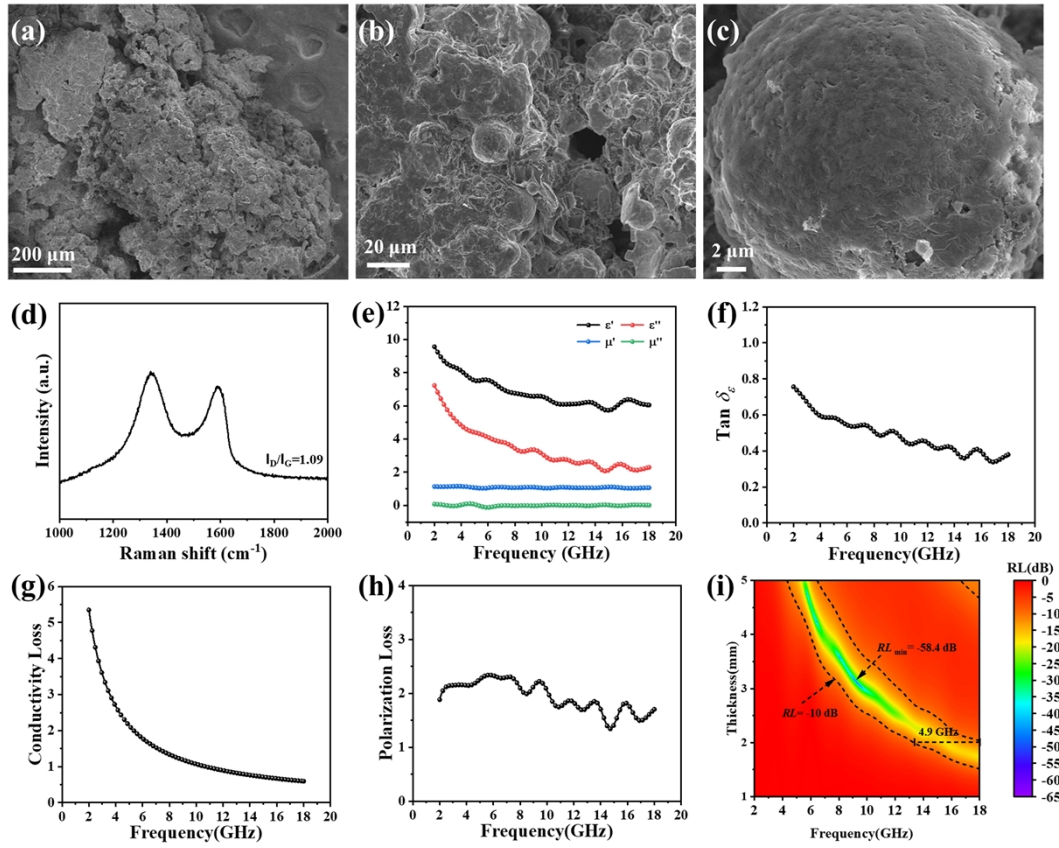


Figure S15 SEM images (a-c), Raman spectra (d), electromagnetic parameters (e) and dielectric loss tangents (f), conductivity loss (g), polarization loss (h), and 2D RL plot (i) of HGMs/GA-TT-70.