Supporting Information

Polarization genes dominated heteroatoms-doped graphene aerogels toward super-efficiency microwave absorption

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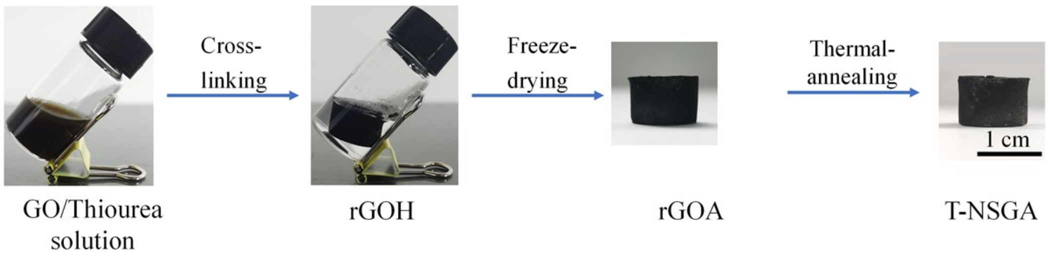

Fig. S1. Schematic illustration of the synthesis process of T-NSGA.

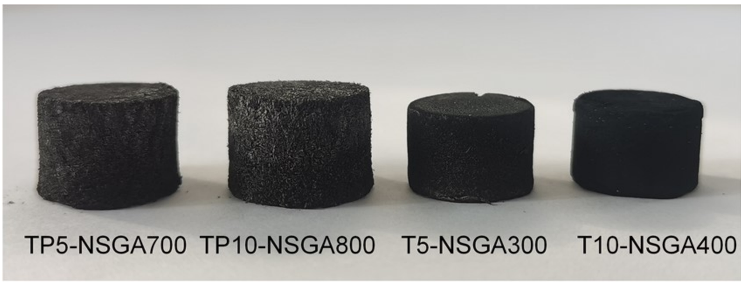

Figure S2. Digital images of NSGAs.

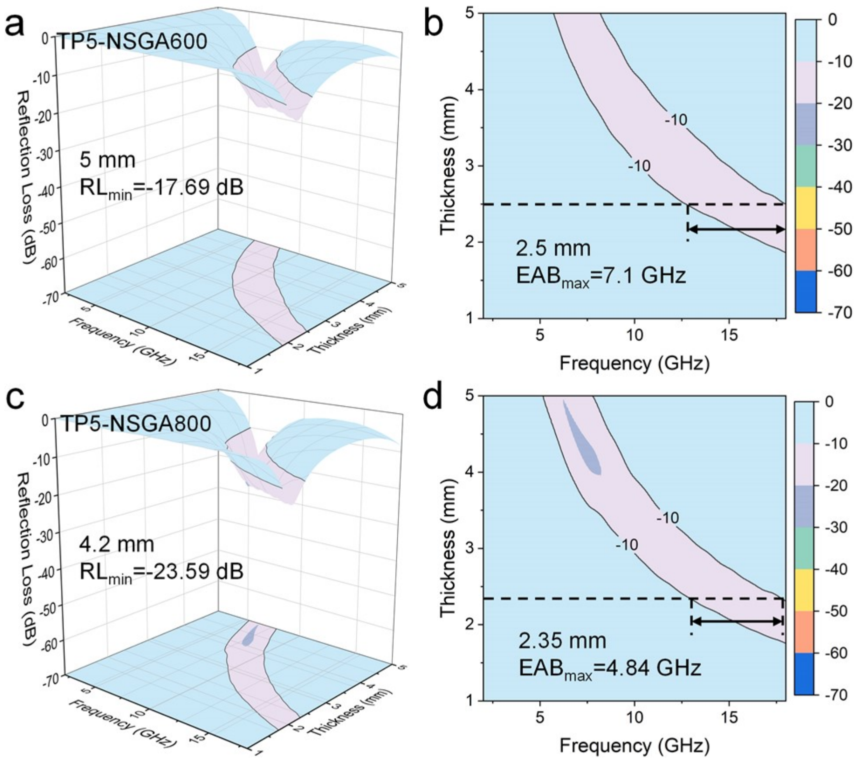

Figure S3. 3D RL and contour map of all samples in the frequency range of 2-18 GHz: (a)-(b) TP5-NSGA600, (c)-(d) TP5-NSGA800.

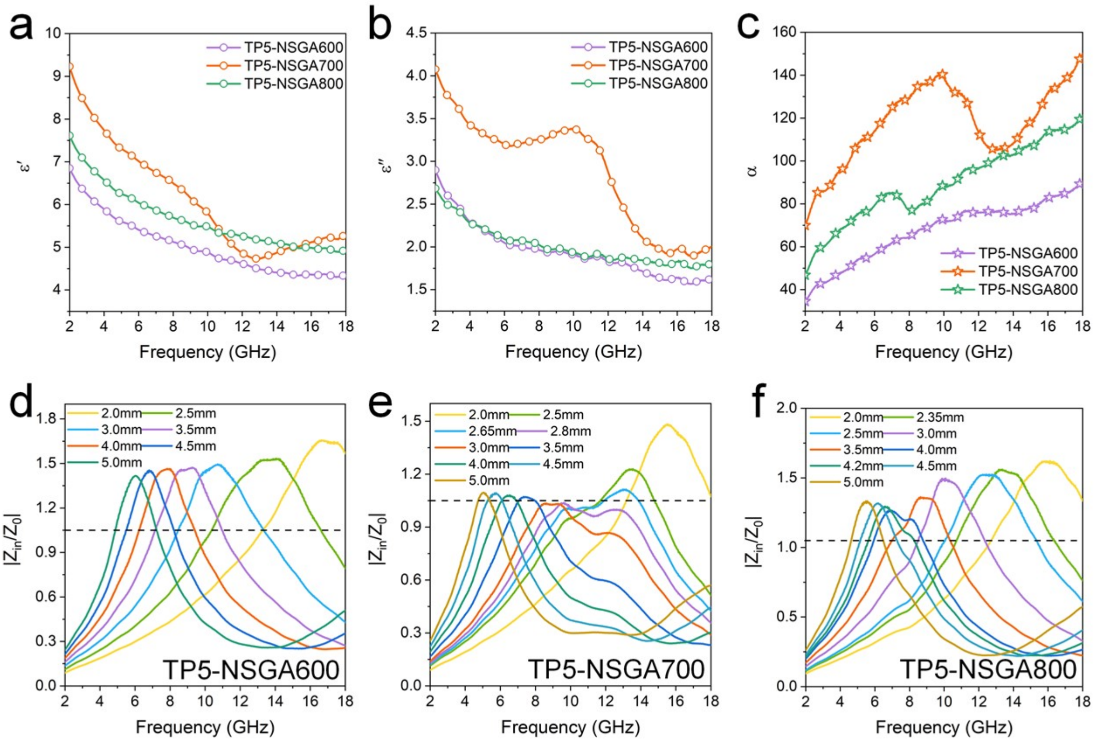

Figure S4. (a) Real and (b) imaginary parts of the complex permittivity, (c) attenuation constant, and (d-f) impedance matching for TP5-NSGA600, TP5-NSGA700 and TP5-NSGA800.

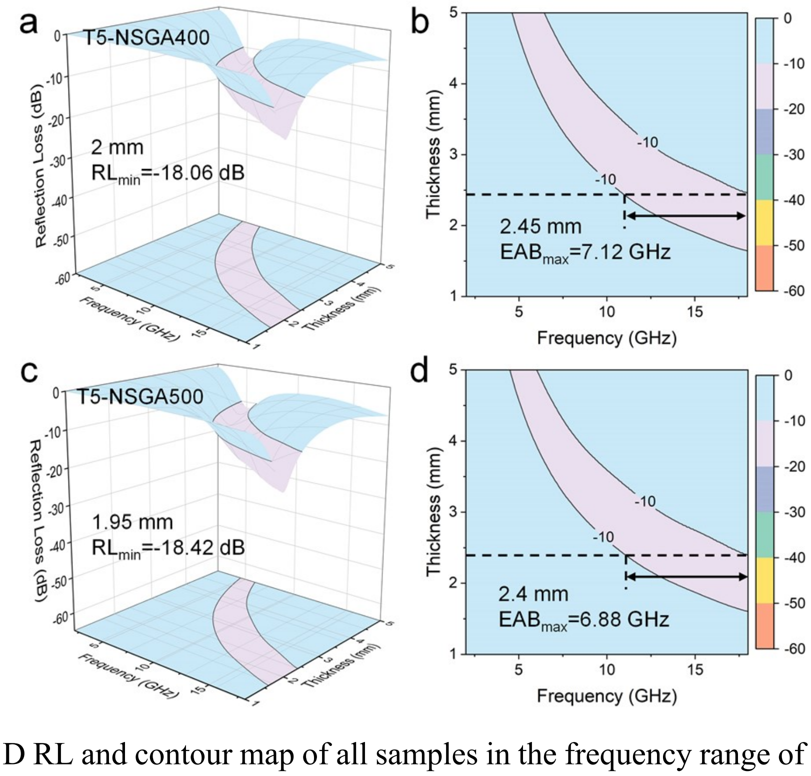

Figure S5. 3D RL and contour map of all samples in the frequency range of 2-18 GHz: (a)-(b) T5-NSGA400, (c)-(d) T5-NSGA500.

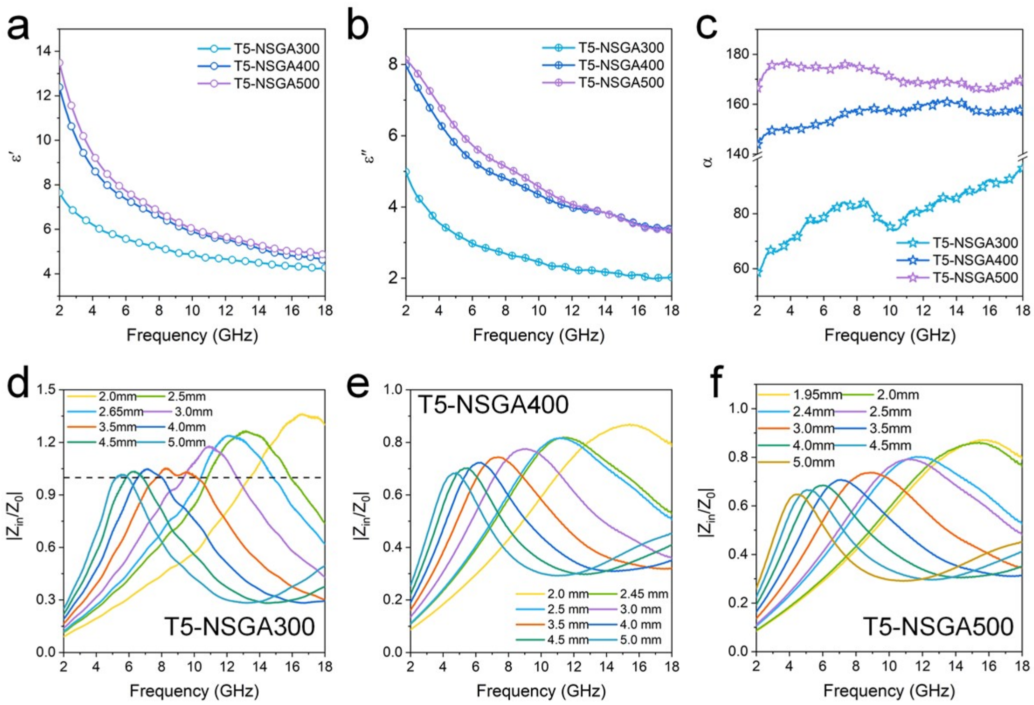

Figure S6. (a) Real and (b) imaginary parts of the complex permittivity, (c) attenuation constant, and (d-f) impedance matching for T5-NSGA300, T5-NSGA400 and T5-NSGA500.

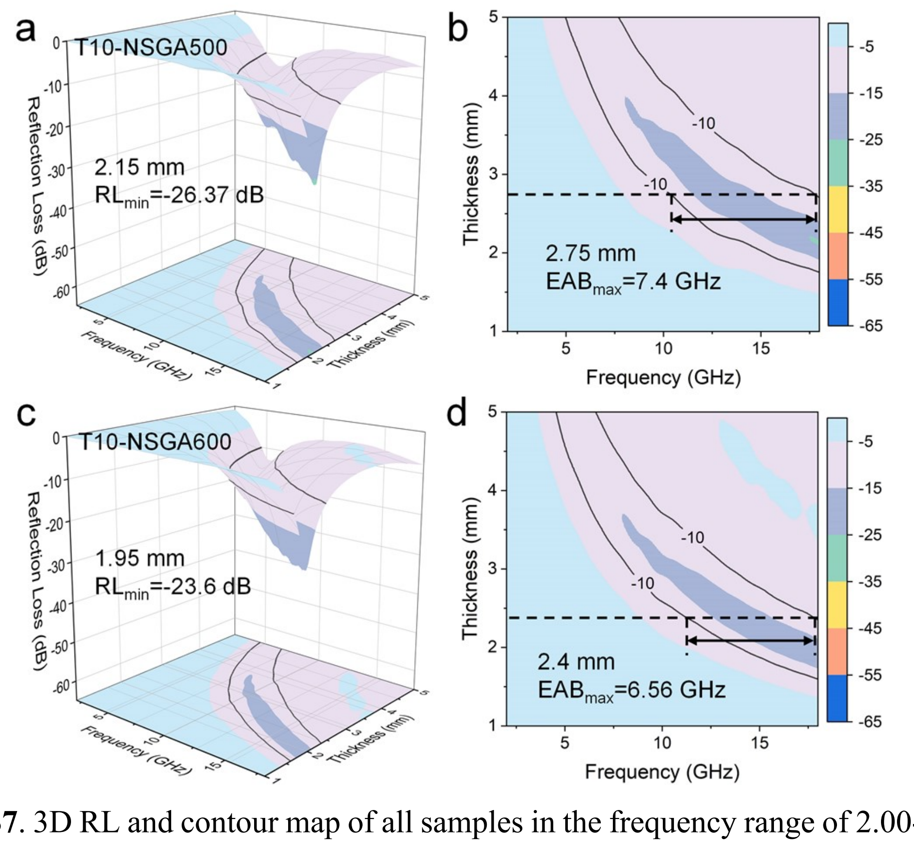

Figure S7. 3D RL and contour map of all samples in the frequency range of 2.00-18.00 GHz: (a)-(b) T10-NSGA500, (c)-(d) T10-NSGA600.

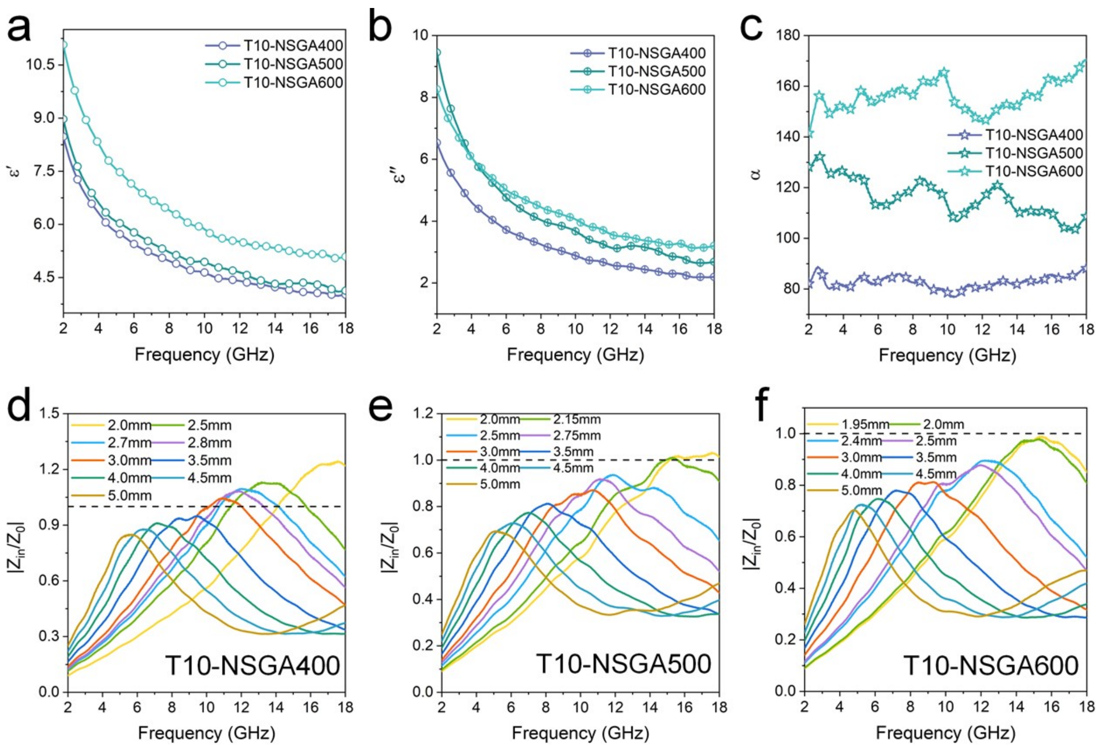

Figure S8. (a) Real and (b) imaginary parts of the complex permittivity, (c) attenuation constant, and (d-f) impedance matching for T10-NSGA400, T10-NSGA500 and T10-NSGA600.

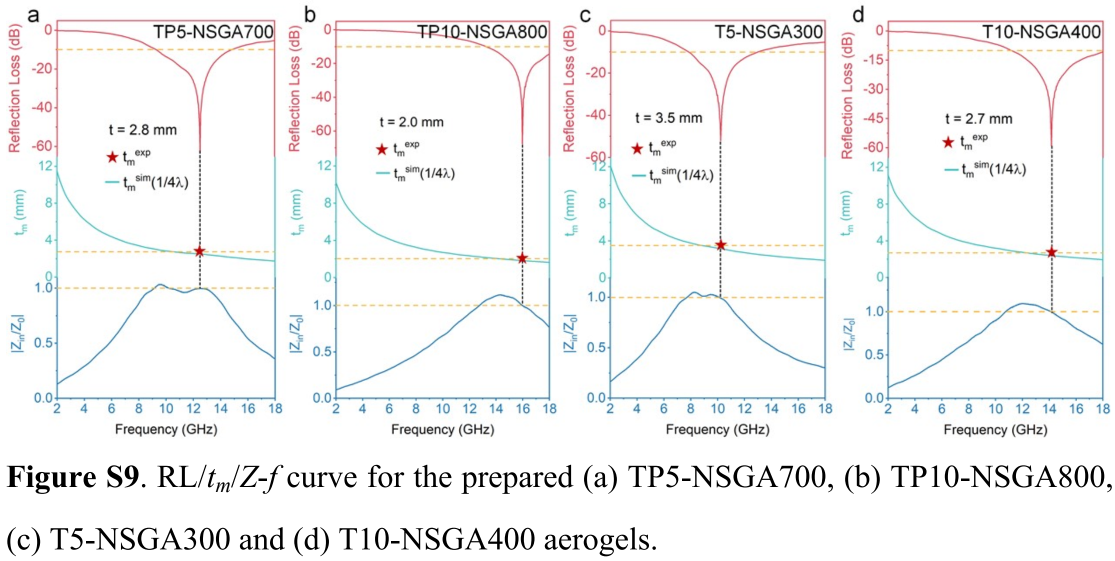

Figure S9. RL/t_m/*Z*-*f* curve for the prepared (a) TP5-NSGA700, (b) TP10-NSGA800, (c) T5-NSGA300 and (d) T10-NSGA400 aerogels.

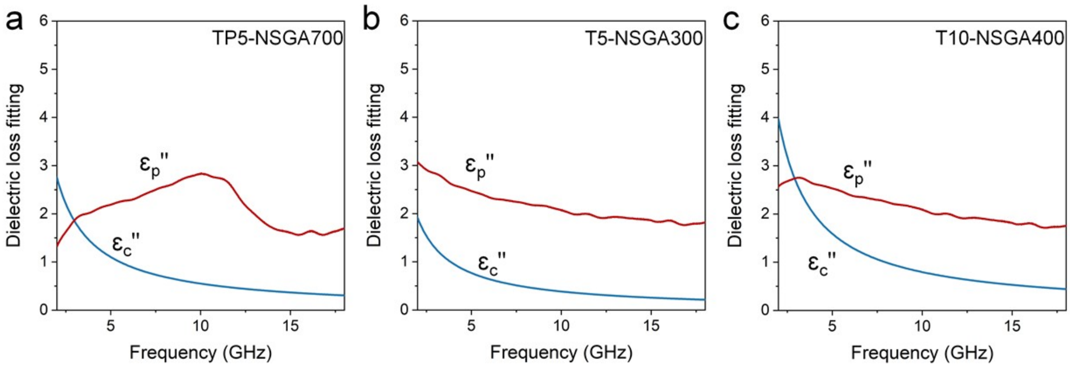

Figure S10. ε_p'' and ε_c'' for (a) TP5-NSGA700, (b) T5-NSGA300 and (c) T10-NSGA400.

Table S1. The initial weight ratios of pyrrole, thiourea and GO of each NSGA and corresponding density and filling loading of NSGAs.

NSGAs	GO: Pyrrole (Weight ratio)	GO: Thiourea (Weight ratio)	Density (mg cm^{-3})	Filling loading (wt%)
TP5-NSGA600	1:2.5	1:2.5	3.77	0.37
TP5-NSGA700	1:2.5	1:2.5	3.14	0.35
TP5-NSGA800	1:2.5	1:2.5	2.91	0.32
TP10-NSGA700	1:5	1:5	4.60	0.53
TP10-NSGA800	1:5	1:5	4.08	0.45
TP10-NSGA900	1:5	1:5	3.56	0.40
T5-NSGA300	-	1:5	5.64	0.65
T5-NSGA400	-	1:5	4.74	0.56
T5-NSGA500	-	1:5	4.61	0.51
T10-NSGA400	-	1:10	4.19	0.47
T10-NSGA500	-	1:10	4.01	0.46
T10-NSGA600	-	1:10	3.82	0.45

Table S2. The comparison of EMW absorption performance, specific RL and SMAP of NSGAs with those of the previously reported light-weight absorbers.

Absorbers	Density/ mg cm^{-3}	RL_{min}/ dB	d/ mm	EAB/ GHz	Content/ wt%	Specific RL/ dB	SMAP/ dB cm^2 g^{-1}	Ref
TP5-NSGA700	3.14	-62.11	2.8	5.64	0.35	***17746***	***70644***	**This work**
TP10-NSGA800	4.08	-67.64	2	6.12	0.45	***15031***	***82892***	**This work**
T5-NSGA300	5.64	-52.06	3.5	6.48	0.65	***8009***	***26373***	**This work**
T10-NSGA400	4.19	-58.98	2.7	7.12	0.47	***12548***	***54134***	**This work**
Atom-doped GA								
NGF	11.6	-53.9	3.5	4.56	5	***1078***	***13276***	[S1]
NRGA	8.7	-56.4	2	6.8	6	***940***	***32414***	[S2]
CoGA	8.8	-49.13	1.5	4.24	5	***983***	***37220***	[S3]
M-NCx	——	-46.2	2	4.7	10	***462***	——	[S4]
Multi-component GA								
FeNi@NC/ NCNT/N-RGOA	13.1	-39.39	2	4.7	10	***394***	***15034***	[S5]
Ni/MXene/RGOA	6.45	-75.2	2.15	7.3	0.64	***11750***	***54227***	[S6]
Fe_3O_4/MWCNT/GF	5	-35.30	3	9.01	10	***353***	***23533***	[S7]
CoNiFe/GA	8.92	-66.23	2.6	6.6	1.1	***6020***	***28557.26***	[S8]
Fe_3O_4@C/RGOA	6.2	-58.1	2.5	7.84	0.7	***8300***	***37483.87***	[S9]
Dielectric GA								
TCNF/GA	13.7	-46.1	3.5	7.1	3.4	***1356***	***9614***	[S10]
ATO/RGOA	10	-40.92	3.3	9.8	1.2	***3410***	***12400***	[S11]
PPy/GA	20	-51.1	3	5.9	50	***102***	***8517***	[S12]
MWCNT/NRGOA	10.8	-69.6	1.8	4.3	8	***870***	***35802***	[S13]
RGO/GONRA	8	-63.52	2.7	8.45	1	***6352***	***29407.41***	[S14]
RGO-BPSiA	56.6	-51.2	3.25	8.4	6.2	***825.81***	***2783.36***	[S15]
CuS@RGOA	15.2	-60.3	3.5	7.84	0.7	***8614***	***11334.59***	[S16]

G/CFA	4.74	-25.5	13.12	8.72	0.44	***5795.45***	***4100.42***	[S17]
N-BCMT/RGOA	12.1	-55.45	3.0	8.36	2	***2772.5***	***15275.48***	[S18]
N-CQD/RGOA	4.24	-69.42	4.09	7.36	5	***1388.4***	***40030.91***	[S19]
Magnetic GA								
RGO/MnOxA	11.2	-56.21	3.44	7.04	10	***562***	***14589***	[S20]
CoNi-NGA	10.9	-43.83	3	4.24	8	***55***	***13403***	[S21]
NIDG	——	-48.68	4.5	4.56	6.2	***785.16***	——	[S22]
GA@Ni	——	-52.3	3	6.7	4.25	***1230.59***	——	[S23]
Ni/GF	——	-29.2	2.60	5.0	1	***2920***	——	[S24]
Pure GA								
RGOA	5.83	-61.63	3.3	7.75	0.74	***8328***	***32034***	[S25]
GA	6.4	-61.09	4.81	6.3	30	***204***	***20851***	[S26]

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