# Supplementary Information

## Nano-absorbers via in-situ surface modification engineering with self-forming heterointerfaces and prominent electromagnetic wave absorption

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**Fig. S1** SAED result of (a) S1, (b) S2, (c) S3, and (d) S4.

**Fig. S2** The statistical particle size of S1-S4.

**Fig. S3** The EDS mapping results of SEM for S2.

**Fig. S4** XPS results of S1-S4.

**Fig. S5** TEM result of S2 after exposure in air for six months.

**Fig. S6** (a) The $M_s$ and $H_c$ of S1-S4; (b) *M*-*T* curves of S1-S4.

**Fig. S7** (a-d) RL-*f* curves under different thicknesses of NA1-NA4. The EAB of (e) NA1 and (f) NA2 at different thicknesses.

**Table S1** The $M_s$ in this work and other works reported currently.

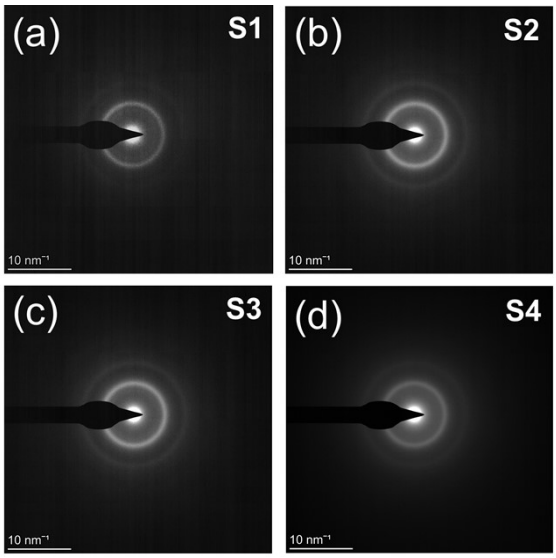


**Fig. S1**

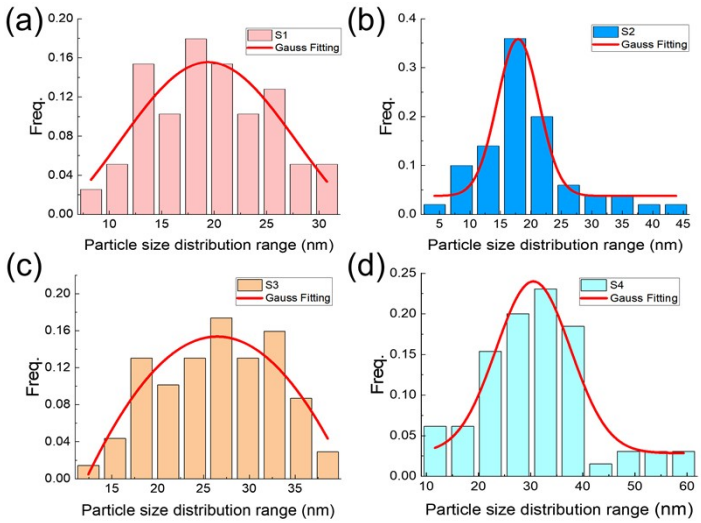
(a)
S1
Gauss Fitting
Freq.
Particle size distribution range (nm)
(b)
S2
Gauss Fitting
Freq.
Particle size distribution range (nm)
(c)
S3
Gauss Fitting
Freq.
Particle size distribution range (nm)
(d)
S4
Gauss Fitting
Freq.
Particle size distribution range (nm)

**Fig. S2**

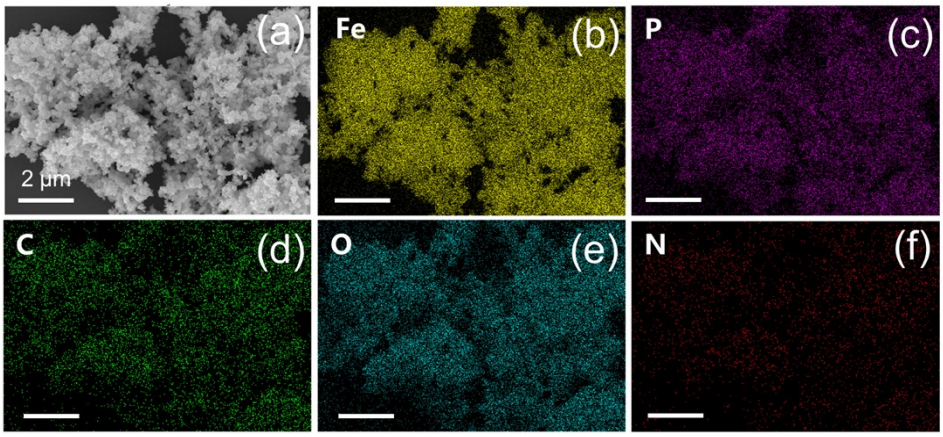


**Fig. S3**

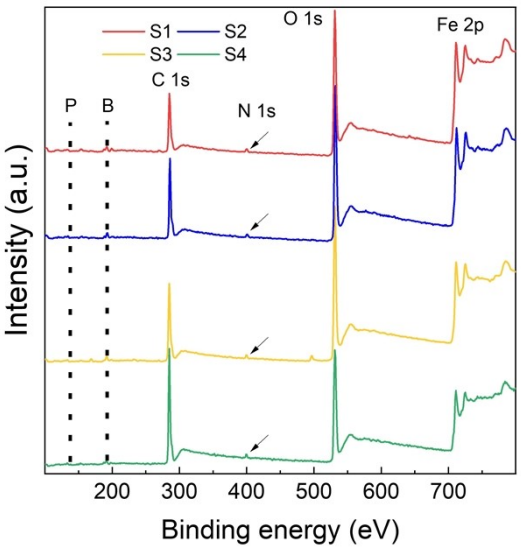
S1
S2
S3
S4
O 1s
Fe 2p
C 1s
P
B
N 1s
Intensity (a.u.)
200
300
400
500
600
700
Binding energy (eV)

**Fig. S4**

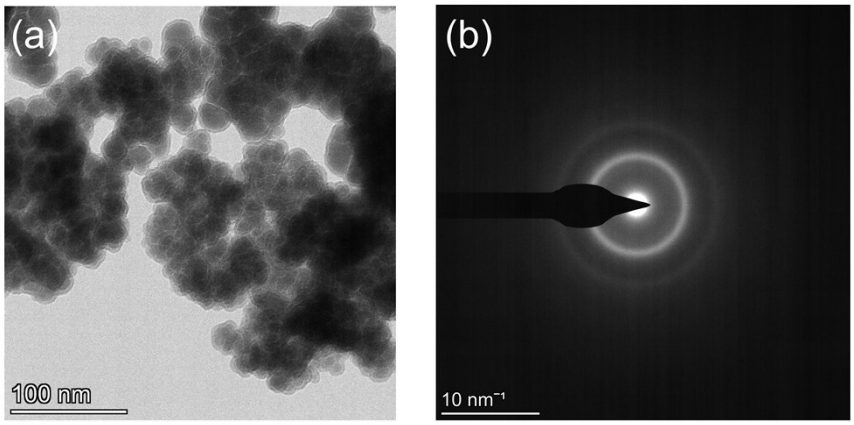


**Fig. S5**

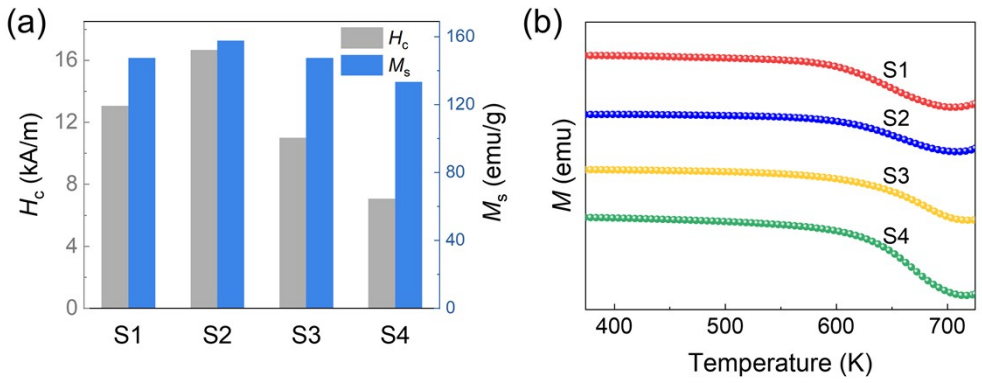
(a)
$H_c$
$M_s$
$H_c$ (kA/m)
$M_s$ (emu/g)
0
4
8
12
16
0
40
80
120
160
S1
S2
S3
S4
(b)
S1
S2
S3
S4
M (emu)
400
500
600
700
Temperature (K)

**Fig. S6**

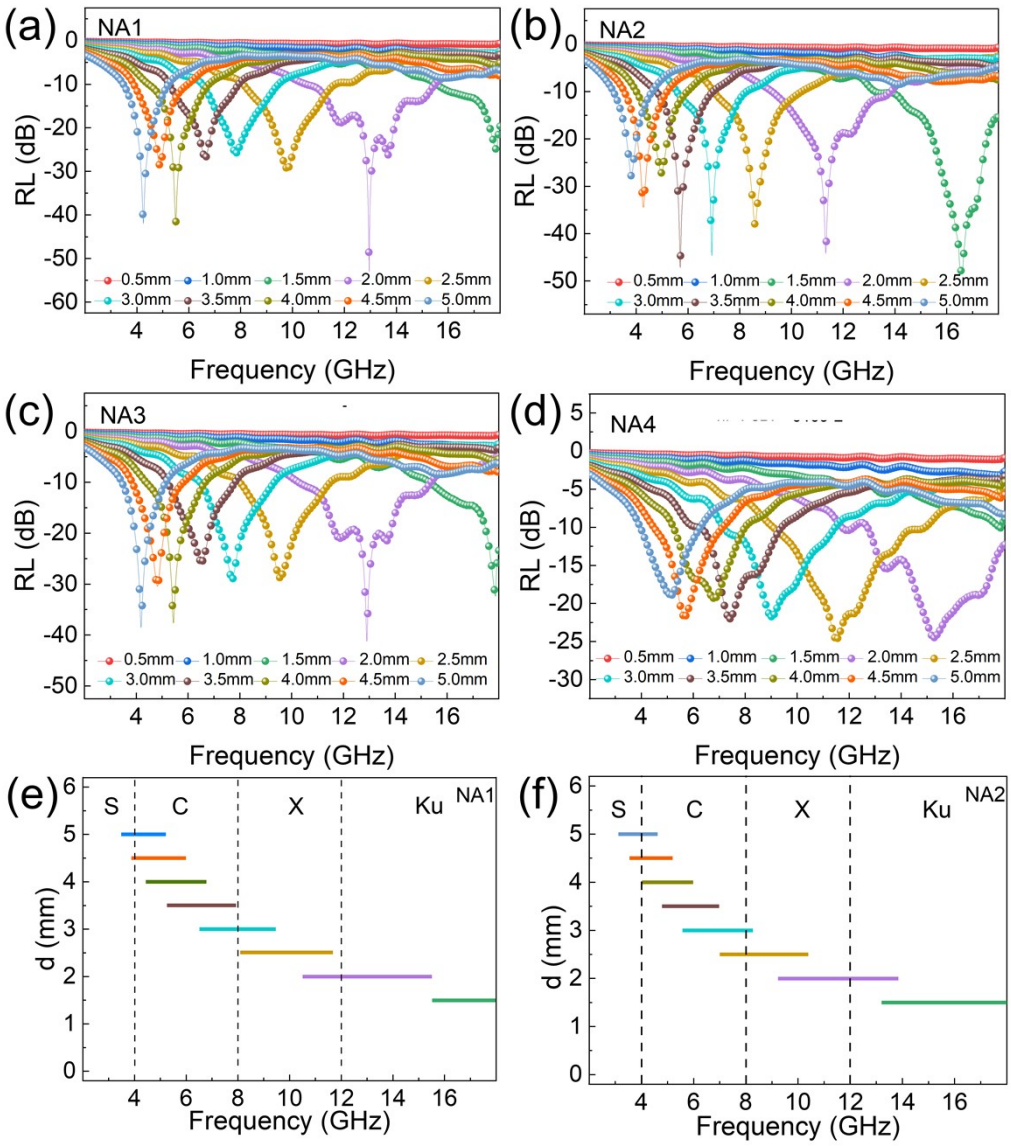
(a)
NA1
RL (dB)
Frequency (GHz)
0.5mm 1.0mm 1.5mm 2.0mm 2.5mm
3.0mm 3.5mm 4.0mm 4.5mm 5.0mm
(b)
NA2
RL (dB)
Frequency (GHz)
(c)
NA3
RL (dB)
Frequency (GHz)
(d)
NA4
RL (dB)
Frequency (GHz)
(e)
S C X Ku
NA1
d (mm)
Frequency (GHz)
(f)
S C X Ku
NA2
d (mm)
Frequency (GHz)

**Fig. S7**

**Table S1**

| Nano-composites | $M_s$ (emu/g) | Refs. |
|---|---|---|
| $Fe_2(MoO_4)_3$@C | 15.42 | [5] |
| $CoFe_2O_4$/RGO@PVP | 54.2 | [10] |
| FeNi/SWCNT | 79.3 | [27] |
| Graphene@$Fe_3O_4$/SiBCN | 20 | [28] |
| Fe-P-2C | 24.3 | [53] |
| S2 | 157 | This work |