Electronic Supporting information

Selectively Assembly of Magnetic Nano-antenna for Electromagnetic Dissipation

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Results and discussion

tan $\delta_{\varepsilon}$and $tan\delta_{\mu}$ can be described as following equation:

$$\tan \delta_{\varepsilon} = \varepsilon''/\varepsilon'$$

$$\tan \delta_{\mu} = \mu''/\mu'$$

The impendence matching degree is assessed by the following equation:

$$Z_{in} = Z_0\sqrt{\mu_r/\varepsilon_r}\tan h\left[j(2\pi fd/c)\sqrt{\mu_r/\varepsilon_r}\right],\ Z_0 = \sqrt{\mu_0/\varepsilon_0},\ Z = \left|Z_{in}/Z_0\right|$$

$$RL = -20log|Z_{in} - 1/Z_{in} + 1|$$

Z_{in} and Z_0 represent to the impedance of input and free space, respectively. ε_r and μ_r are the relative complex permittivity ($\varepsilon_r = \varepsilon' - j\varepsilon''$) and permeability ($\mu_r = \mu' - j\mu''$). The microwave frequency, absorber thickness and light velocity are *f*, *d* and *c* respectively.

The attenuation ability (α) of the EMW absorbing materials can be evaluated by the equation:

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

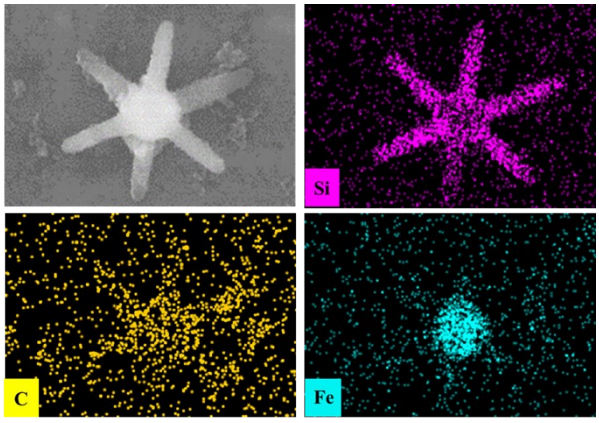

Fig. S1 EDS elemental mapping of FSF-0

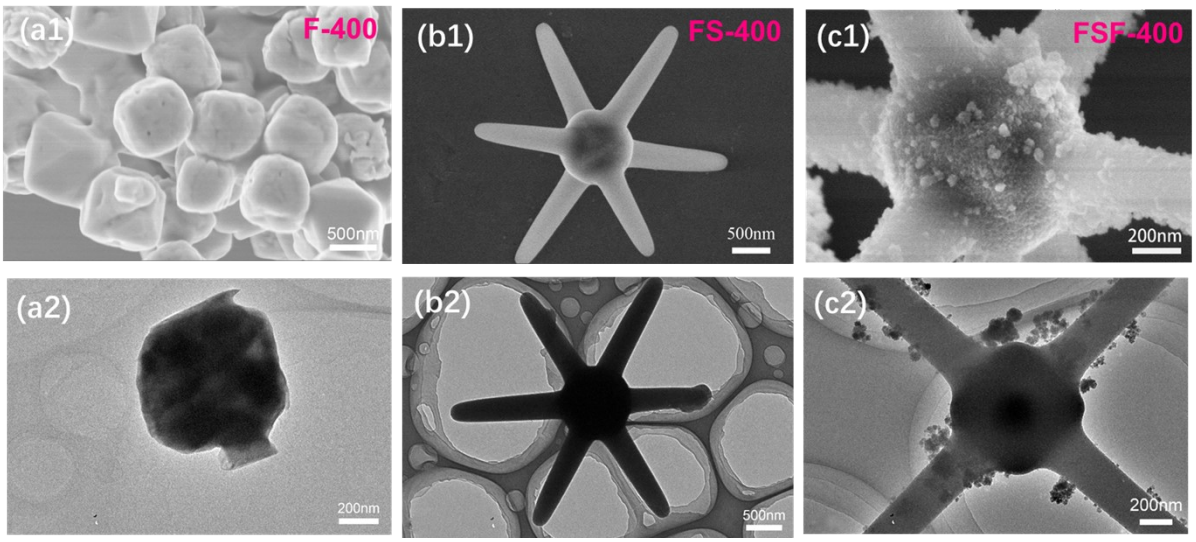

Fig. S2 SEM and TEM images of (a) F-400, (b) FS-400, (c) FSF-400.

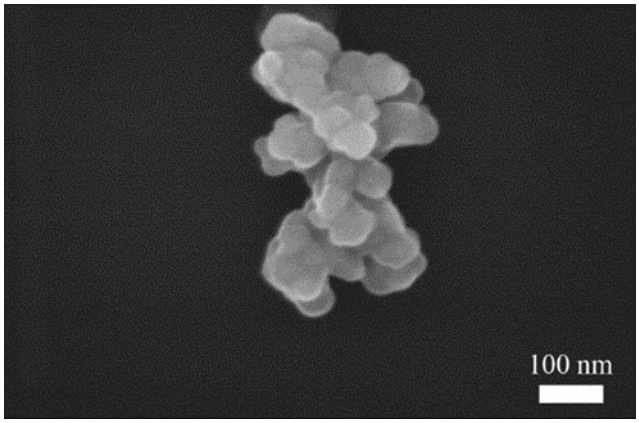

Fig. S3 SEM image of Fe_3O_4.

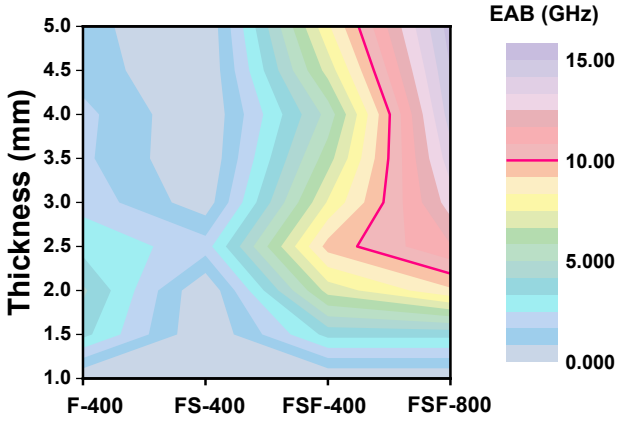

Fig. S4 2D contour map of EAB and thickness.

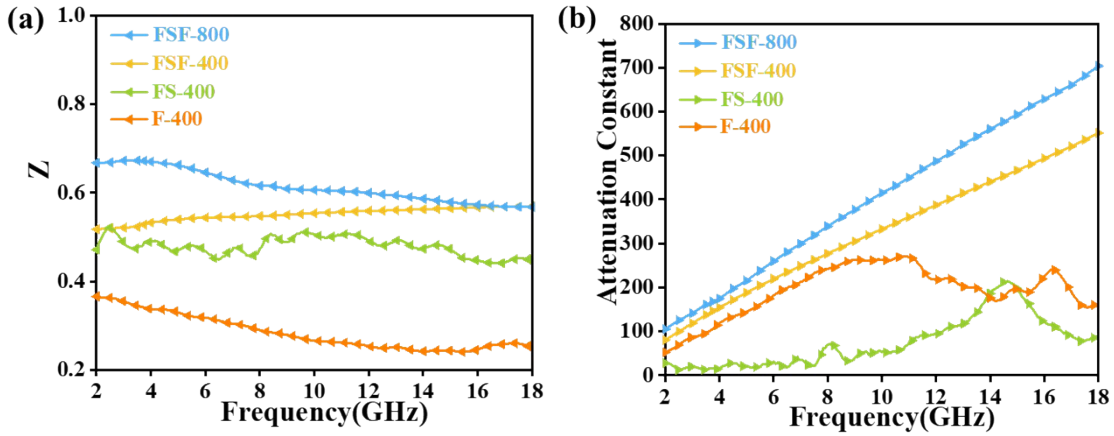

Fig. S5 (a) Impedance matching constant (Z) and (b) attenuation constant (α) of the composites.

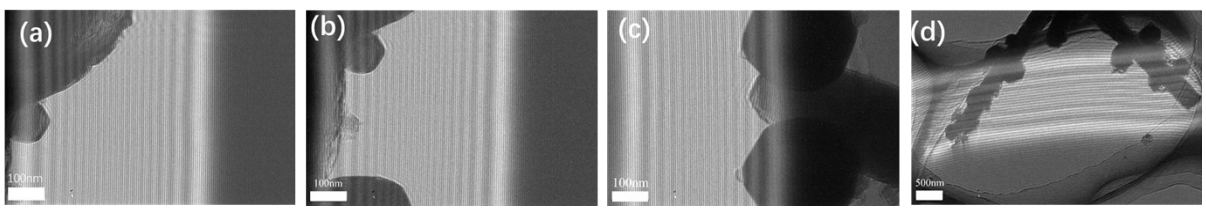

Fig. S6 The electron holography images of (a) cubic core, (b) cubic core and magnetic particle on silica column, (c) magnetic particles on the same silica column and (d) different magnetized silica columns

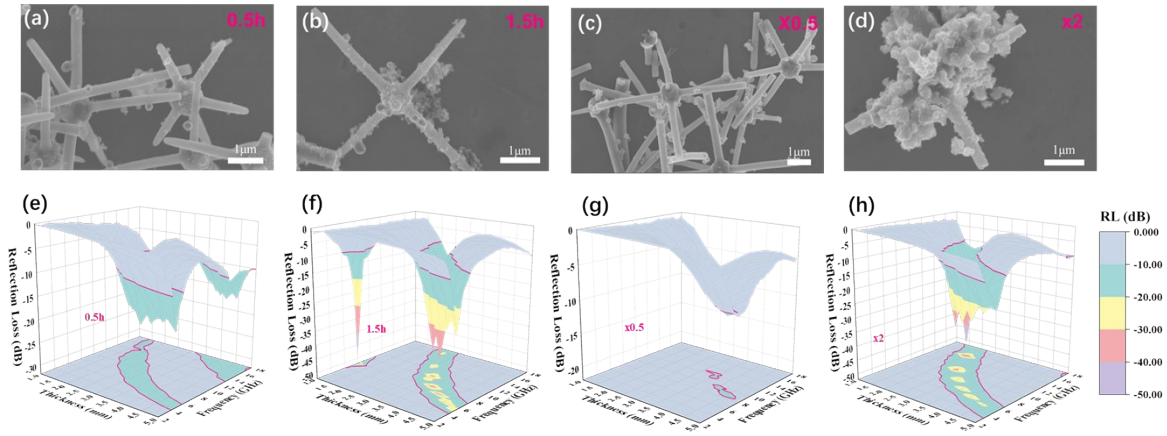

Fig. S7 SEM image of FSF-800 with (a) 0.5h, (b) 1.5h mixing time; and FSF-800 with (c) half and (d) double loading amount.

Table S1. Microwave absorption performance of related iron materials

Ref.	Materials	Reflection Loss	EAB
Ref. 1[1]	Fe/MnO@C core–shell nanocapsules embedded in porous amorphous carbon matrix	-45 dB	5.0 GHz
Ref. 2[2]	Fe/N-codoped carbon nanospheres	-49.08 dB	14.9 GHz
Ref. 3[3]	Fe/SiC Hybrid Fibers	-46.3 dB	4.0 GHz
Ref. 4[4]	Fe/C porous nanofibers	-56.6 dB	3.0 GHz
Ref. 5[5]	leaf-like Fe/C composites	-59.7 dB	6.0 GHz
Ref. 6[6]	Fe/C nanocubes	-20.3 dB	7.2 GHz
Ref. 7[7]	hollow microspheres with Fe@Carbon dual-shells	-54.4 dB	8.1 GHz
Ref. 8[8]	1D/2D Fe	-57.3 dB	11.5 GHz
Ref. 9[9]	Fe@MoS2	-37.02 dB	4.73 GHz
Ref. 10[10]	Fe–C nanofibers	-44 dB	11.0 GHz
This work	Fe@SiO2@Fe	-44.1 dB	15.2 GHz

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