Supplementary data

MnO_2-Coated Necklace-Like CoFe@Carbon Nanofiber Composites for Superior Electromagnetic Wave Absorption

Yiliang Liu [a], Ying Lin*[a], Zhixin Cai [a], Yongzhen Ma [a], Hongwei Zhou [a], Wei Chai [a], Qibin Yuan [b] and Haibo Yang*[a]

[a]*Shaanxi Key Laboratory of Green Preparation and Functionalization for Inorganic Materials, School of Materials Science and Engineering, Shaanxi University of Science and Technology, Xi'an, Shaanxi 710021, China.*

[b]*School of Electronic Information and Artificial Intelligence, Shaanxi University of Science and Technology, Xi'an, Shaanxi 710021, China.*

*Corresponding authors:

Tel: +86-29-86168688

Fax: +86-29-86168688

(Ying Lin) E-mail: linying@sust.edu.cn

(Haibo Yang) E-mail: yanghaibo@sust.edu.cn

Calculation of Weight Ratios for $Co_{0.7}Fe_{0.3}$, CNFs, and MnO_2 in CFCM Composites:

The amount of CFC composites added each time in the hydrothermal reaction is one-quarter of the amount collected in a single spinning process.

1. Calculation of $Co_{0.7}Fe_{0.3}$ Weight:

m_{CoFe}=m_{PAB} × Residual Rate (%)

CoFe-PBA Pyrolysis Residue Rate: ~60% (at 700 °C).

2. Calculation of CNFs Weight:

m_{CNFs} =m_{PAN} × Carbonization yield (%)

PAN Fiber Carbonization Yield: ~50% (at 700 °C).

3. Calculation of MnO_2 Weight:

$2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2\uparrow$

m_{MnO_2} =m_{2KMnO_4} × Hydrothermal Reaction (%)

$KMnO_4$ Hydrothermal Reaction Yield: ~85% (at 120 °C for 6 h).

Weight Ratio:

$$m_{Co_{0.7}Fe_{0.3}} \Big/ m_{CNFs} \Big/ m_{MnO_2} = \frac{m_{Co_{0.7}Fe_{0.3}}}{\sum m_{total}} \Bigg/ \frac{m_{CNFs}}{\sum m_{total}} \Bigg/ \frac{m_{MnO_2}}{\sum m_{total}}$$

Table. S1 Calculation of weight ratio for CFCM composites.

		Precursor	Conversion ratio	Collection volume	Weight ratio
CFCM-1	$Co_{0.7}Fe_{0.3}$	75 mg	60%	45 mg	12.86%
	CNFs	100 mg	50%	50 mg	14.29%
	MnO_2	600 mg	85%	255 mg	72.85%
		sum		350 mg	
CFCM-2	$Co_{0.7}Fe_{0.3}$	150 mg	60%	90 mg	22.78%
	CNFs	100 mg	50%	50 mg	12.65%
	MnO_2	600 mg	85%	255 mg	64.57%
		sum		395 mg	
CFCM-3	$Co_{0.7}Fe_{0.3}$	225 mg	60%	135 mg	30.68%
	CNFs	100 mg	50%	50 mg	11.36%
	MnO_2	600 mg	85%	255 mg	57.96%
		sum		440 mg	

Equation: S1: Calculation of *L*a Value:

The *L*a value of the sample is calculated according to the following equation:

$$La = \frac{C}{\left(\frac{I_D}{I_G}\right)} \tag{1}$$

where C is 4.4 nm under the laser wavelength condition of 532 nm, and I_D and I_G are the integrated intensities of the D peak and G peak, respectively.

Table. S2 *L*a values of each sample are calculated based on Raman spectroscopy.

	*L*a (nm)
CFC-2	4.07
CFCM-1	4.04
CFCM-2	4.11
CFCM-3	4.19

Equation S2: Calculate Element Content Based on XPS:

The elemental content of the prepared sample was calculated according to the equation:

$$C_x = \frac{I_x / S_x}{\sum I_x / S_x} \quad (2)$$

where I is the peak intensity of each element, S is the sensitivity factor of each element, and C is the relative percentage content of the element.

Table. S3 Percentage content of each element is calculated based on XPS.

Peak	Intensity	Sensitivity	I/S	Conc
C 1s	620421	0.205	3026444	61.57%
N 1s	156702	0.28	559650	11.39%
O 1s	563003	0.63	893656	18.18%
Fe 2p	357507	3.8	94081	1.91%
Co 2p	425067	4.5	94459	1.92%
Mn 2p	518901	2.1	247096	5.03%
	Sum		4915386	

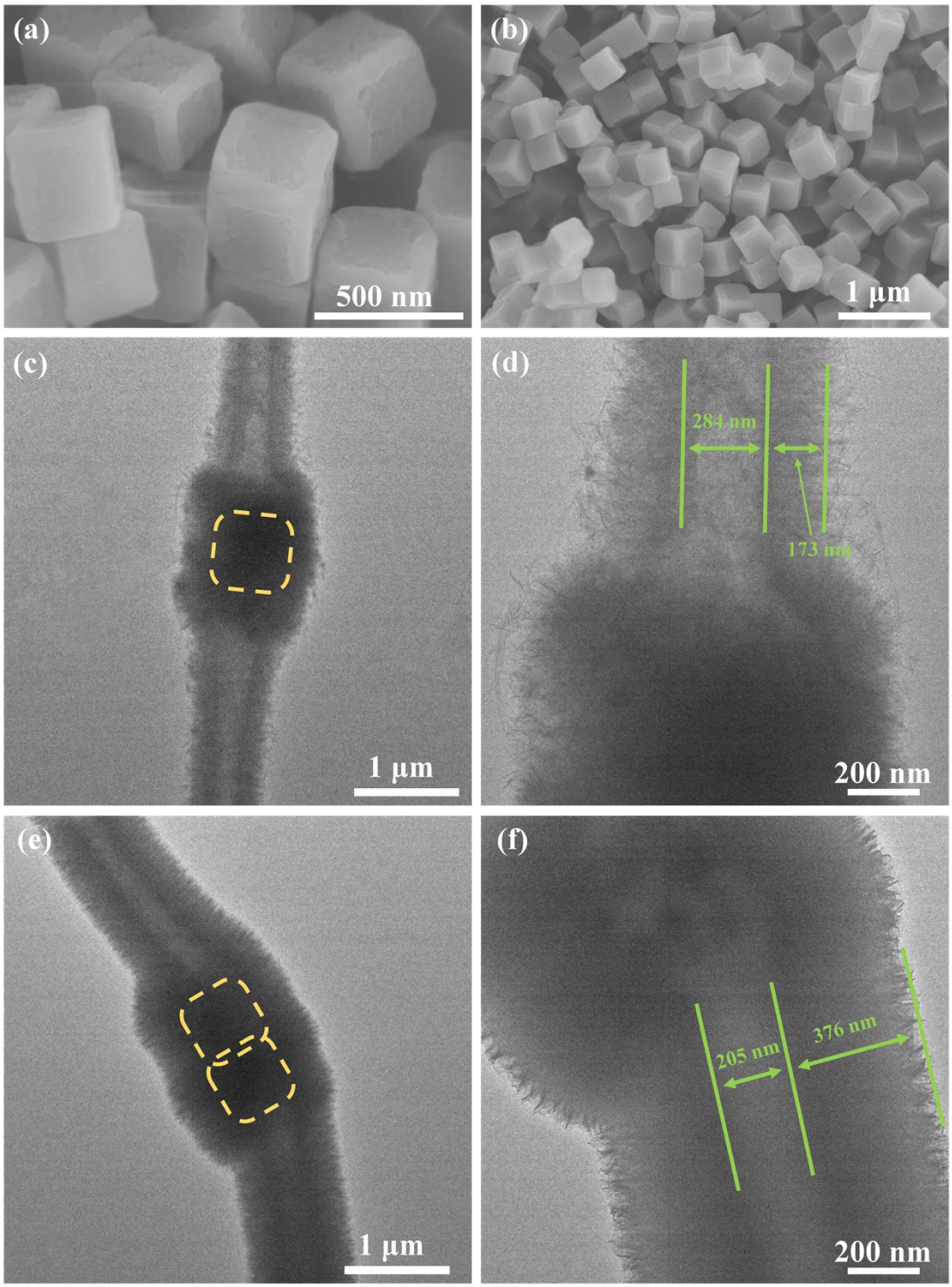

Fig. S1 (a, b) SEM images of CoFe-PBA.TEM images of (c, d) CFCM-2a and (e, f) CFCM-2b.

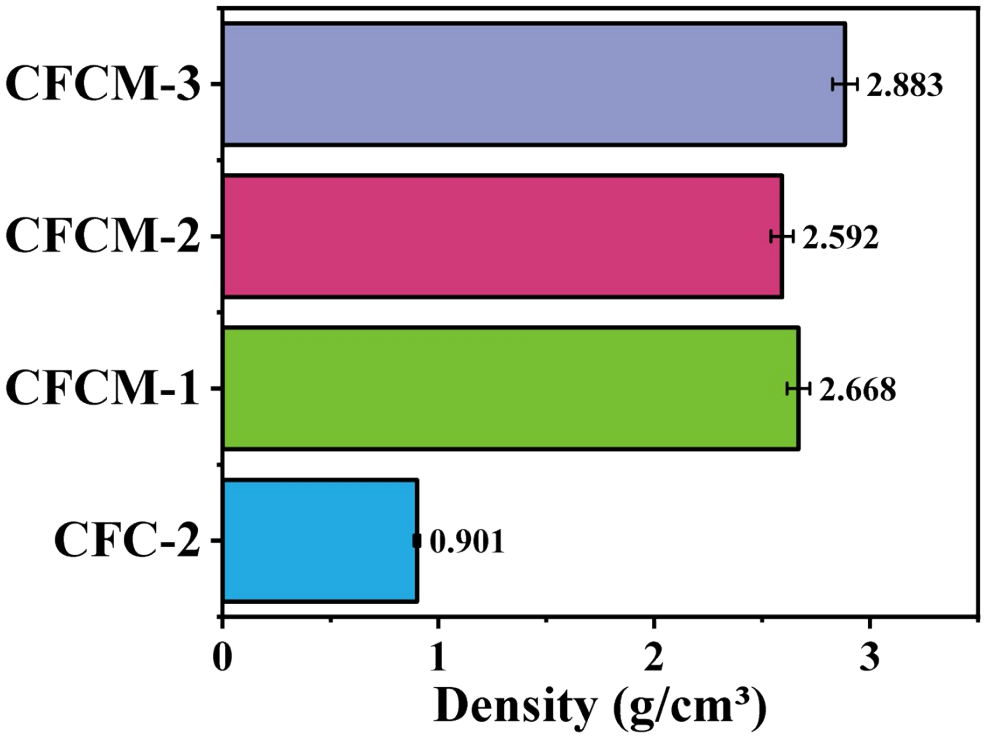

Fig. S2 Density of CFC-2 and CFCM composites.

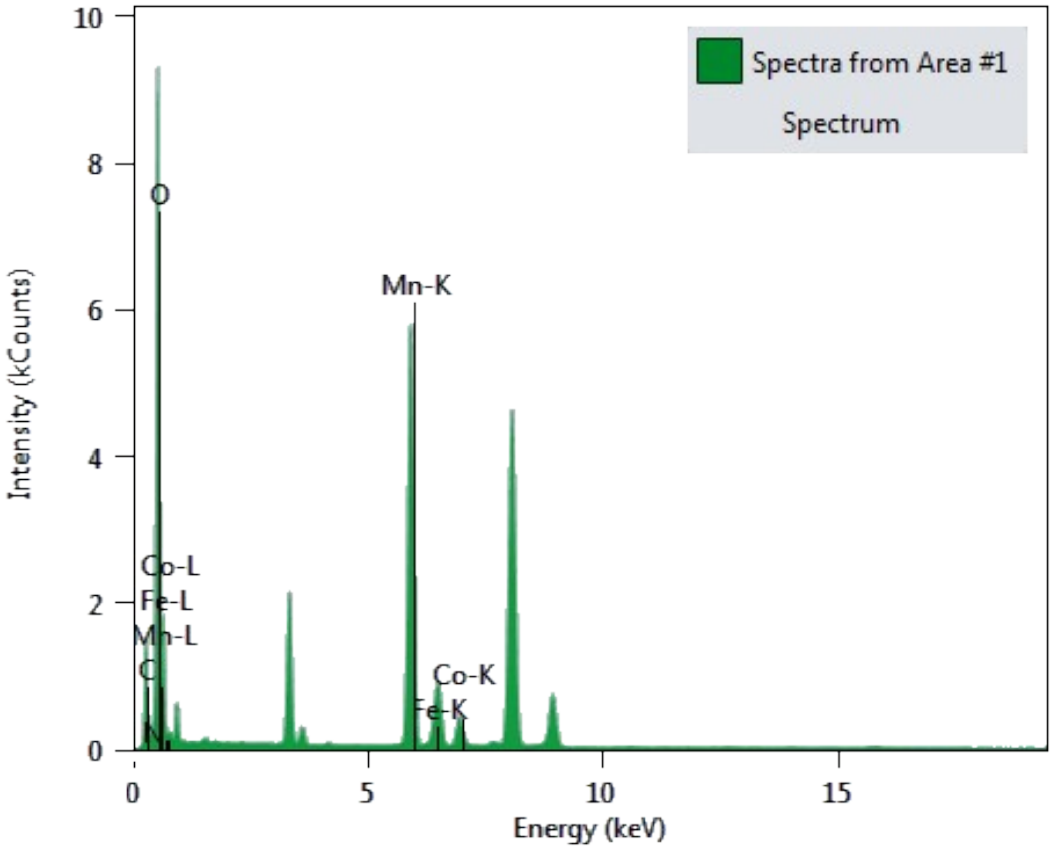

Fig. S3 EDS spectrum of CFCM-2.

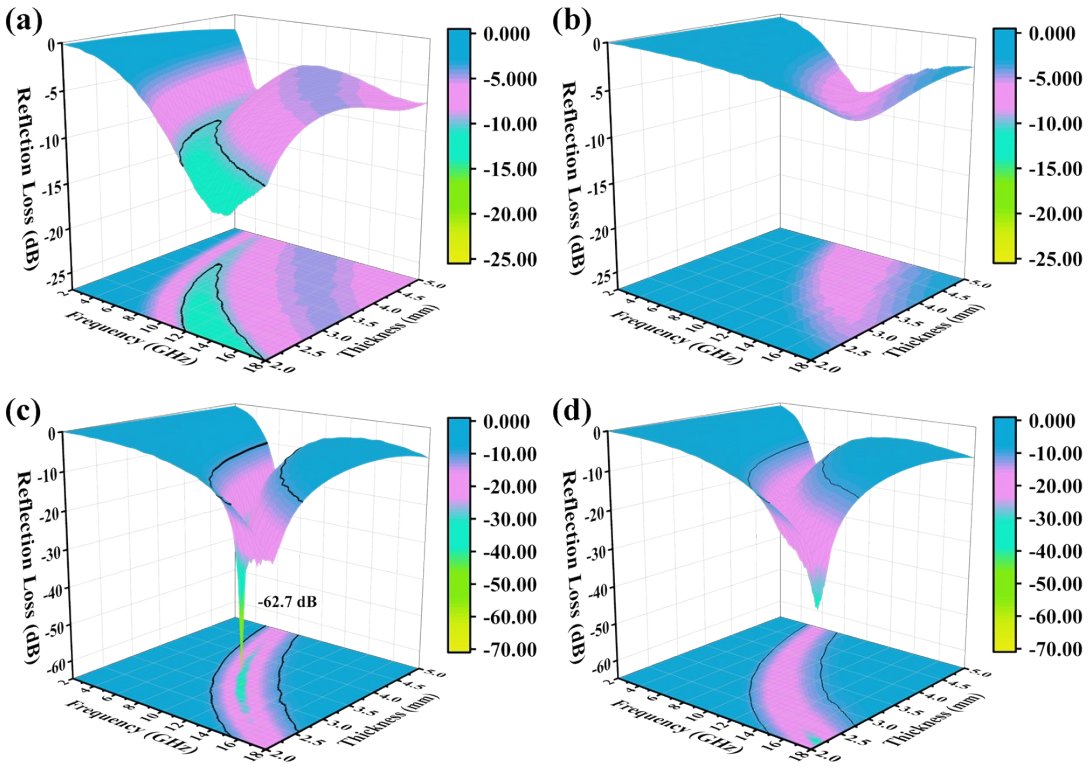

Fig. S4 3D RL_{min} maps of (a) CFC-2, (b) CFCM-1, (c) CFCM-2 and (d) CFCM-3.

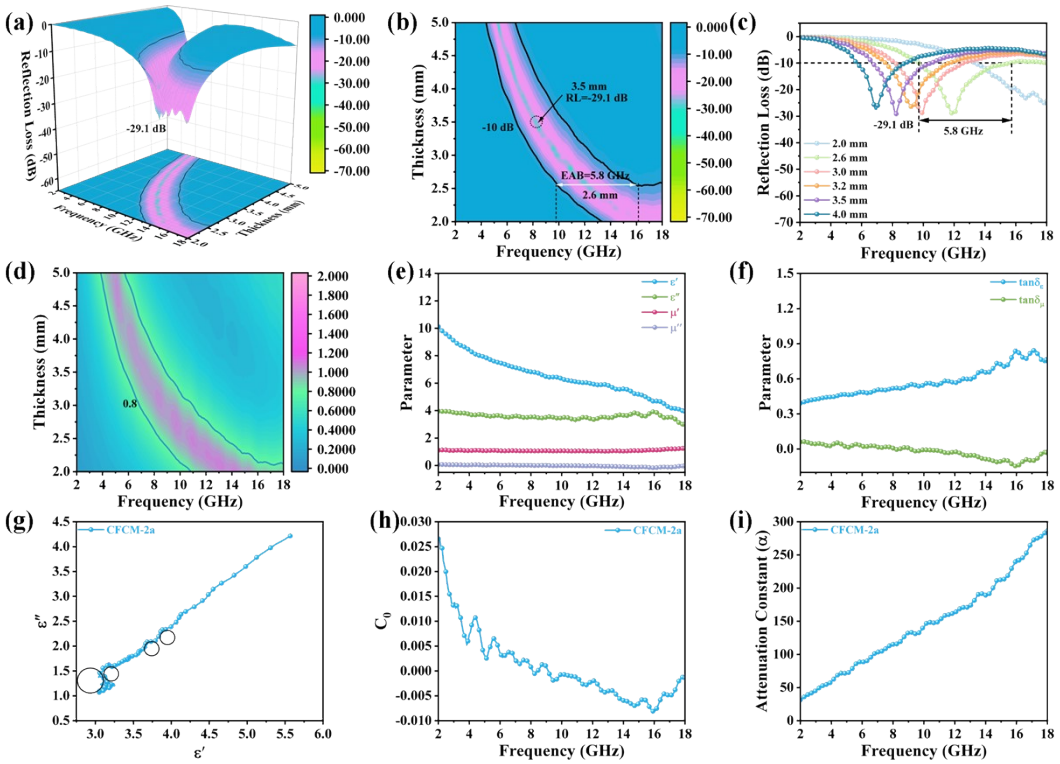

Fig. S5 (a) 3D RL_{min} map, (b) 3D RL_{min} projection plot, (c) 2D RL_{min} curves, (d) 3D impedance matching value projection plot, (e, f) electromagnetic parameters, (g) Cole-Cole curve, (h) C_0 value and (i) attenuation constant of CFCM-2a.

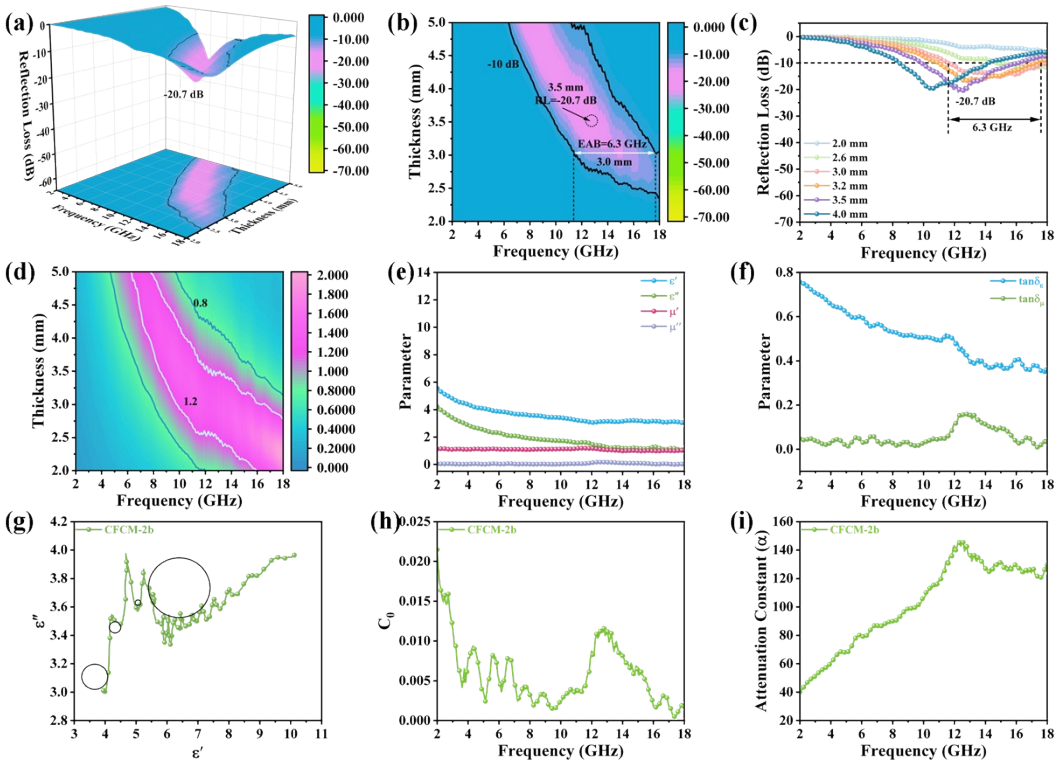

Fig. S6 (a) 3D RL_{min} map, (b) 3D RL_{min} projection plot, (c) 2D RL_{min} curves, (d) 3D impedance matching value projection plot, (e, f) electromagnetic parameters, (g) Cole-Cole curve, (h) C_0 value and (i) attenuation constant of CFCM-2b.

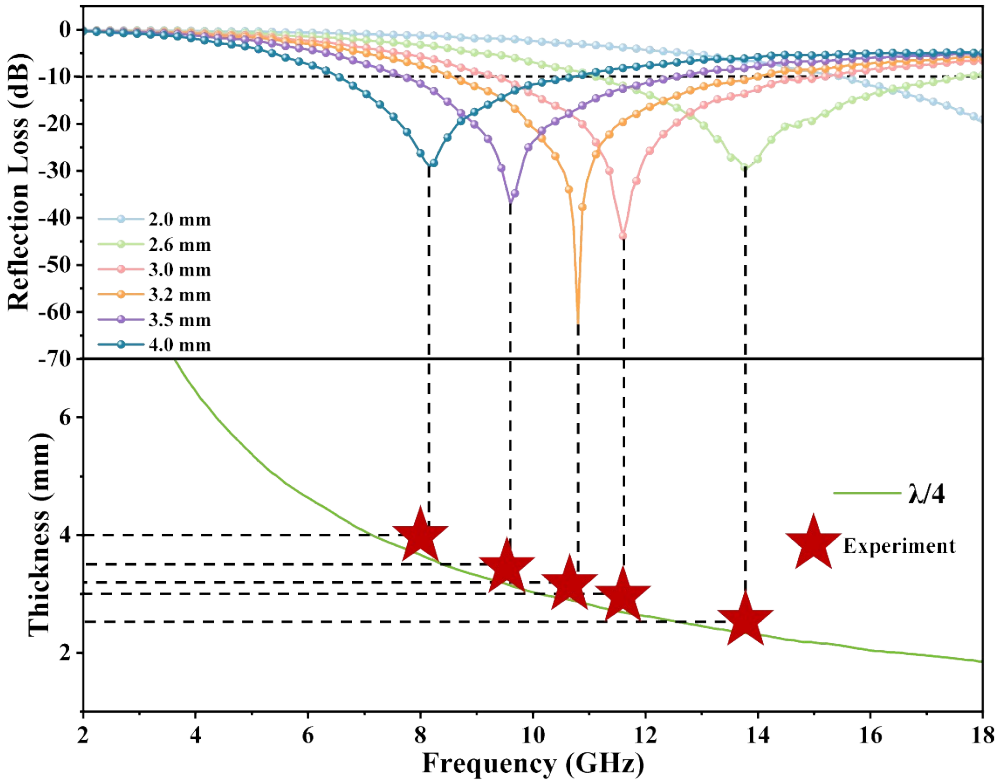

Fig. S7 simulations of the thickness of CFCM-2 (t_m) versus peak frequency (f_m) of CFCM-2 under the λ/4 model.

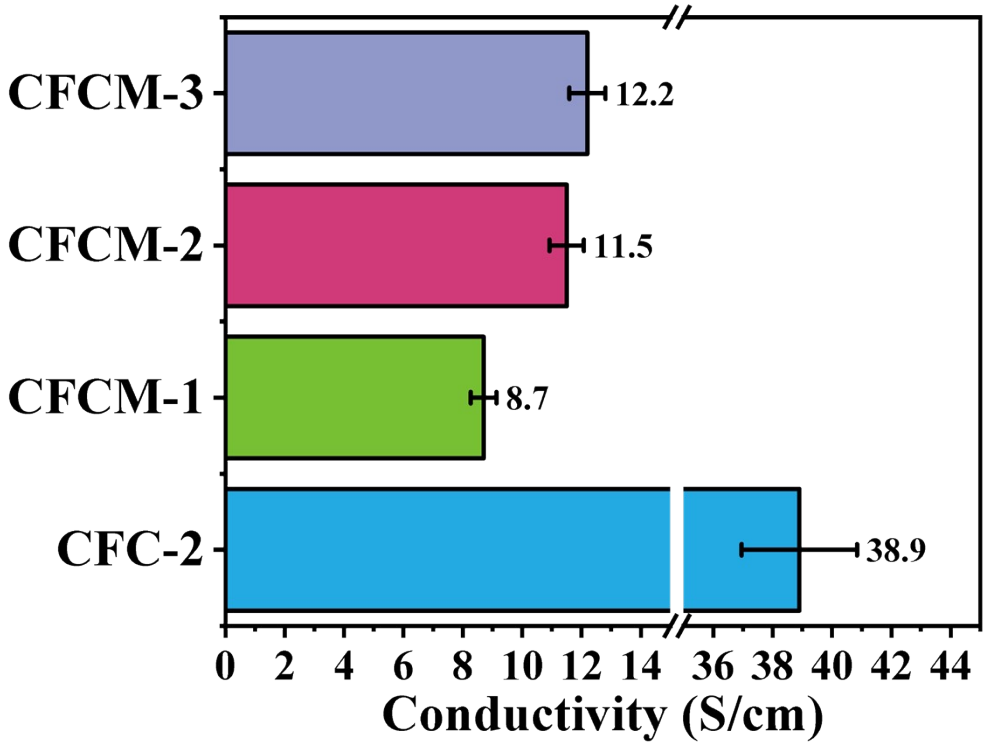

Fig. S8 Conductivity of CFC-2 and CFCM composites.

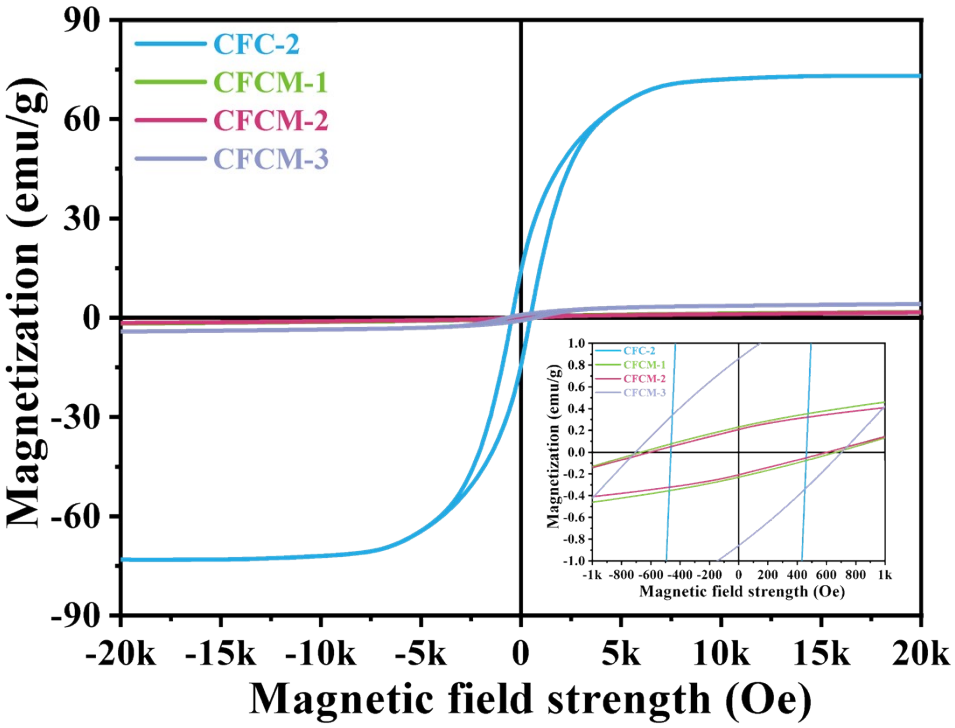

Fig. S9 Magnetic field strength (Oe) of CFC-2 and CFCM composites.