Supporting Informations:

SiC-Fe_3O_4 dielectric-magnetic hybrid nanowires: controllable fabrication, characterization and electromagnetic wave absorption

Caiyun Liang,[a] Chenyu Liu,[a] Huang Wang ,[a] Lina Wu,[b] Zhaohua Jiang,[a] Yongjun Xu,[a] Baozhong Shen[b] and Zhijiang Wang*[a]

[a] School of Chemical Engineering and Technology, Harbin Institute of Technology, Harbin 150001, China;

[b] Department of Medical Imaging and Nuclear Medicine, the 4th Affiliated Hospital, Harbin Medical University, Harbin 150001, China;

Corresponding Author

Tel.&Fex: +86 451 86418409

E-mail address: wangzhijiang@hit.edu.cn

1. Morphology of fracture surface of SiC/Fe_3O_4 hybrids/paraffin composite.

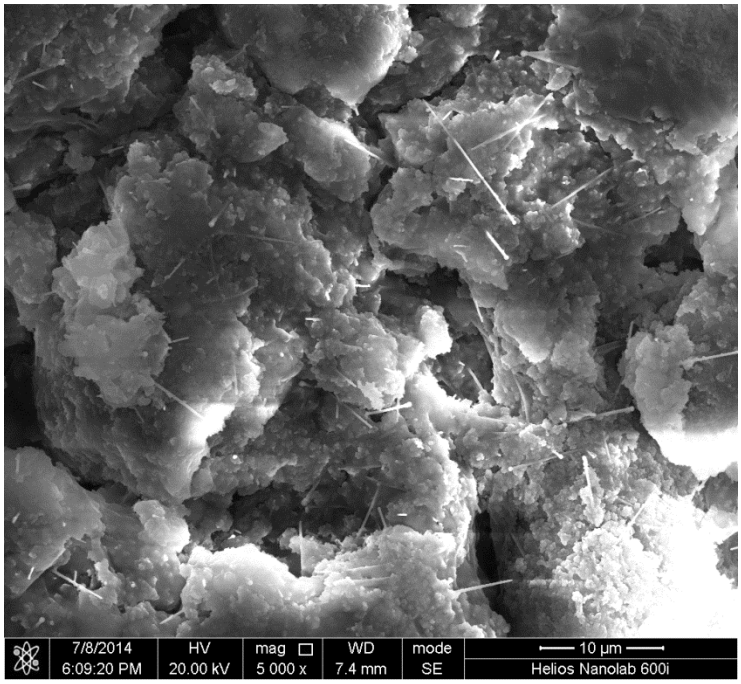

Figure S1. SEM image of a fracture surface of SiC/Fe_3O_4 hybrids/paraffin composite. The SEM image reveals that the SiC/Fe_3O_4 hybrids are randomly embedded in the paraffin, forming a network structure in the matrix without aggregation.

2. Magnetization of pure Fe_3O_4 nanoparticles with core size of around 10 nm.

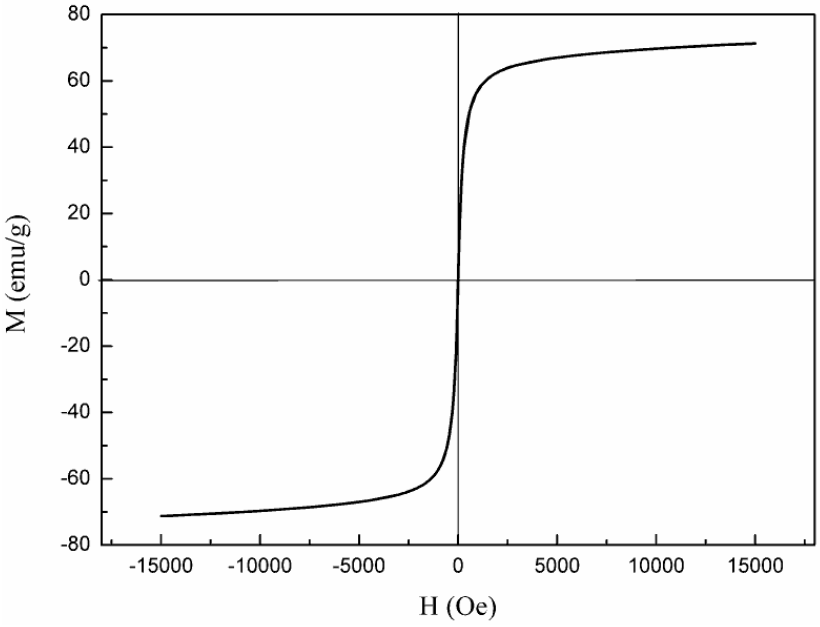

Figure S2. Room-temperature field-dependent magnetization curves of Fe_3O_4 nanoparticles with core size of around 10 nm.

3. EM parameters of samples

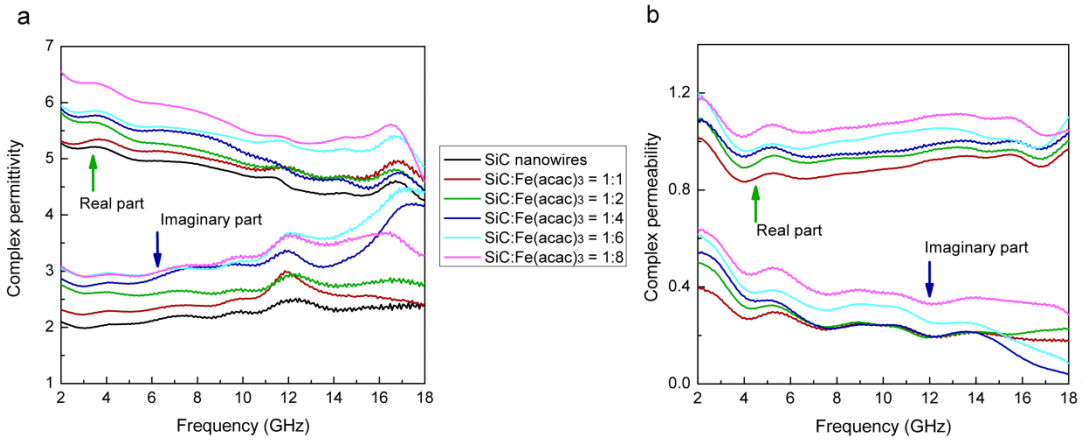

Figure S3. The frequency dependence of complex permittivity (a) and permeability (b) of samples in the range of 2-18 GHz.

4. Skin depth of the samples

The skin depth is defined as the distance up to which the intensity of the EM wave within the material decreases to 1/e of its original strength. The skin depth (δ) is related to angular frequency, ac conductivity and permeability as

$$\delta = \sqrt{\frac{2}{\omega \sigma_{ac} \mu}} \qquad \text{(S1)}$$

where ω is the angular frequency, σ_{ac} is the conductivity, and μ is the permeability.

Ac conductivity is calculated by using following equation:

$$\sigma_{ac} = \omega \varepsilon_0 \varepsilon'' \qquad \text{(S2)}$$

where ε_0 is permittivity of the free space, and ε'' is the imaginary part of permittivity.

Table S1 is the summary of values of ac conductivity and skin depth for SiC/Fe_3O_4 hybrids samples.

Table S1. Ac conductivity and skin depth values for SiC/Fe_3O_4 hybrids samples

$SiC:Fe_3O_4$ hybrids samples	σ (S/m) (f=2 GHz)	δ (S/m) (f=18 GHz)	δ (mm) (f=2 GHz)	δ (mm) (f=18 GHz)
SiC/Fe_3O_4 hybrids $_{SiC:Fe(acac)3=1:1}$	0.26	2.4	20.9	2.4
SiC/Fe_3O_4 hybrids $_{SiC:Fe(acac)3=1:4}$	0.32	4.2	18.1	1.7
SiC/Fe_3O_4 hybrids $_{SiC:Fe(acac)3=1:8}$	0.34	3.3	16.6	1.9

5. TG-FTIR analysis

The TG-FTIR experiment were performed simultaneously using a thermogravimeter (Pyris 1) and FTIR spectroscope (Frontier) under He atmosphere at 20 ^{o} C/min. A Perkin elmer's coupling system (Tl-9000) is equipped to combine these two instruments together.

Figure S4 shows the TG-DSC curves of the SiC/Fe_3O_4 hybrids produced from $SiC/Fe(acac)_3$ = 1:4. The first weight loss is at the range of 70-200 ºC. The second stage of weight loss is at the range of 200-380 ºC. It has been reported that the first slight amount of weight loss is attributed to the evaporation of adsorbed water and ethanol. The second stage of weight loss at range of 200-380 ºC corresponds to the removal of triethylene glycol (TREG) in the sample.[1-4] To confirm this speculation, FT-IR analysis of volatile matter obtained at different temperature are carried out.

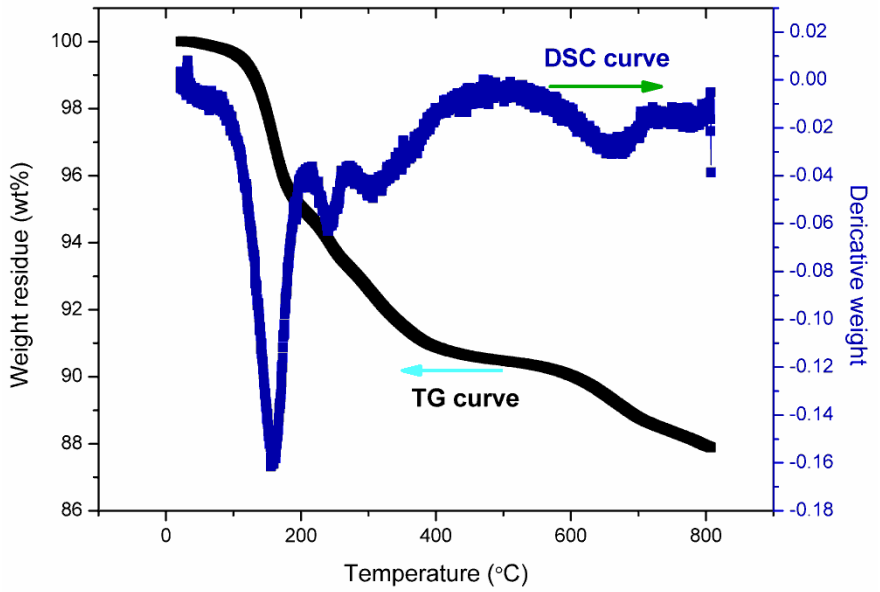

Figure S4. TG-DSC curves of SiC/Fe_3O_4 hybrids produced from $SiC/Fe(acac)_3$ = 1:4

Figure S5-a, S5-b, S5-c and S5-d show the FT-IR (attached on TG) spectra of the volatile matter from as-prepared SiC/Fe_3O_4 hybrids when heated at temperature of 100 ºC, 120 ºC, 240 ºC and 280 ºC, respectively.

In Figure S5-a and S5-b, the peaks at about 1546 and 1698 cm^{-1} are due to C-H stretching, O-H stretching of ethanol. The peaks at about 3700 cm^{-1} is due to H_2O. These results indicated that the weight loss at 70-200 ºC is caused by the evaporation of adsorbed water and ethanol.

In Figure S5-c and S5-d, the peaks at about 2892, 1736, 1518 and 1138 cm^{-1} are due to C-H stretching, O-H stretching, C-H bending, C-O bending vibration of triethylene glycol (TREG). The broad band at about 3700 cm^{-1} is assigned to the O-H stretching vibration of water and the peak at about 2400 cm^{-1} is due to CO_2 which may be from the decomposition of TREG. These results confirmed that the weight loss at 200-380 ºC is caused by the removal of TREG in the sample.

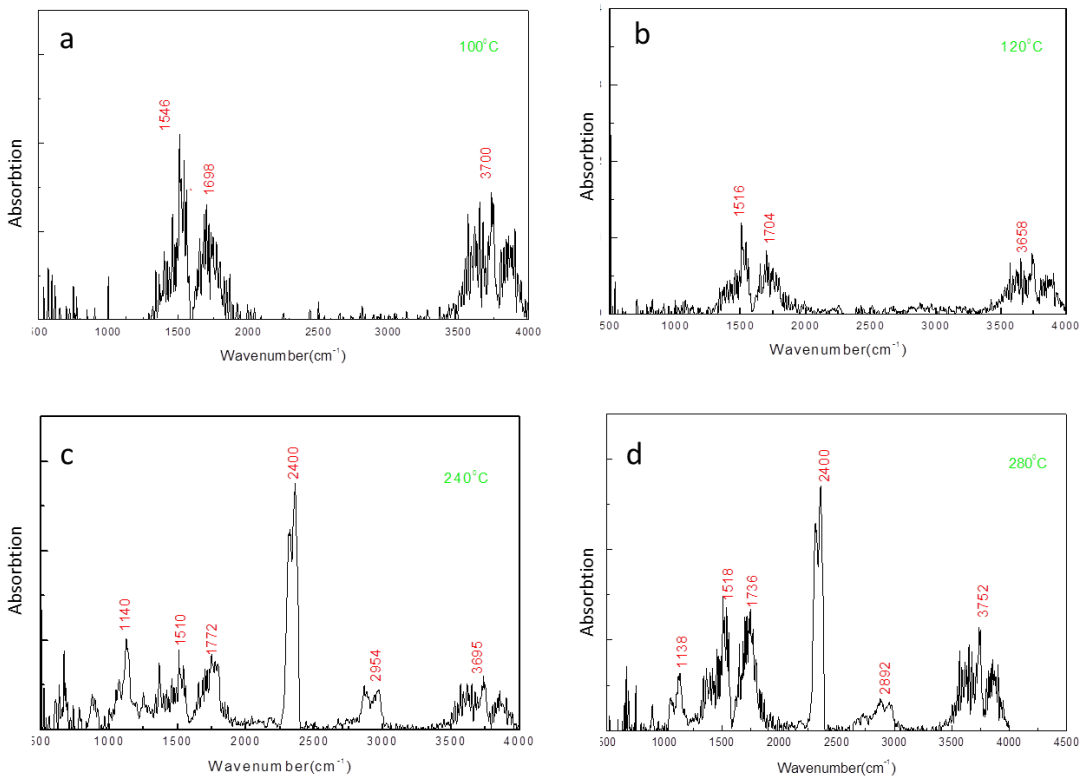

Figure S5. FT-IR spectrum of volatile matter from as-prepared SiC/Fe_3O_4 hybrids when heated at temperature of 100 ºC (a), 120 ºC (b), 240 ºC (c) and 280 ºC (d).

The TG-FTIR measurement confirms that the weight loss at 70-200 ºC is attributed to the evaporation of adsorbed water and ethanol in the SiC/Fe_3O_4 hybrids sample. Weight loss at range of 200-380 ºC corresponds to the removal of triethylene glycol (TREG) in the sample.

References:

1. D. Maity, S. N. Kale, R. Kaul-Ghanekar, J.-M. Xue and J. Ding, *Journal of Magnetism and Magnetic Materials*, 2009, **321**, 3093-3098.
2. D. Maity and D. C. Agrawal, *Journal of Magnetism and Magnetic Materials*, 2007, **308**, 46-55.
3. W. Cai and J. Wan, *Journal of Colloid and Interface Science*, 2007, **305**, 366-370.
4. D. Maity, P. Chandrasekharan, F. Si-Shen, J.-M. Xue and J. Ding, *Journal of Applied Physics*, 2010, **107**, 09B310.