Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information

Design of porous C@Fe_3O_4 hybrid nanotubes toward their excellent microwave absorption

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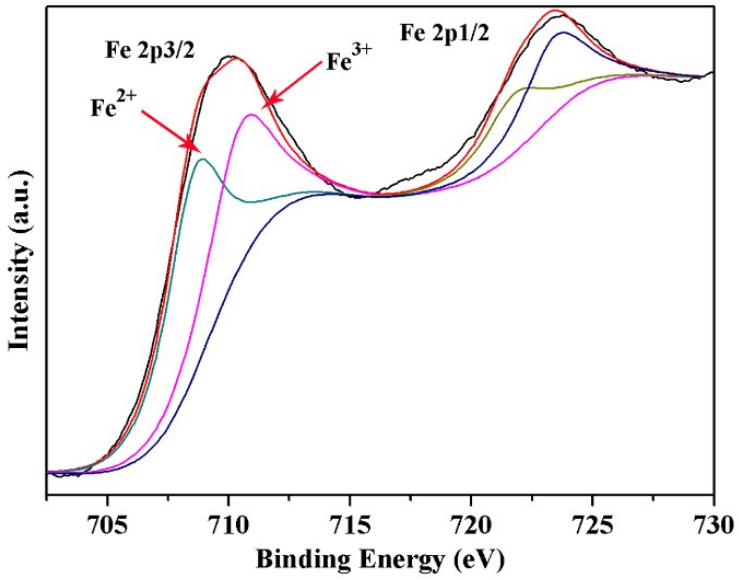

Fig. S1 XPS spectra of Fe 2p for porous Carbon@Fe_3O_4 core-shell nanotubes

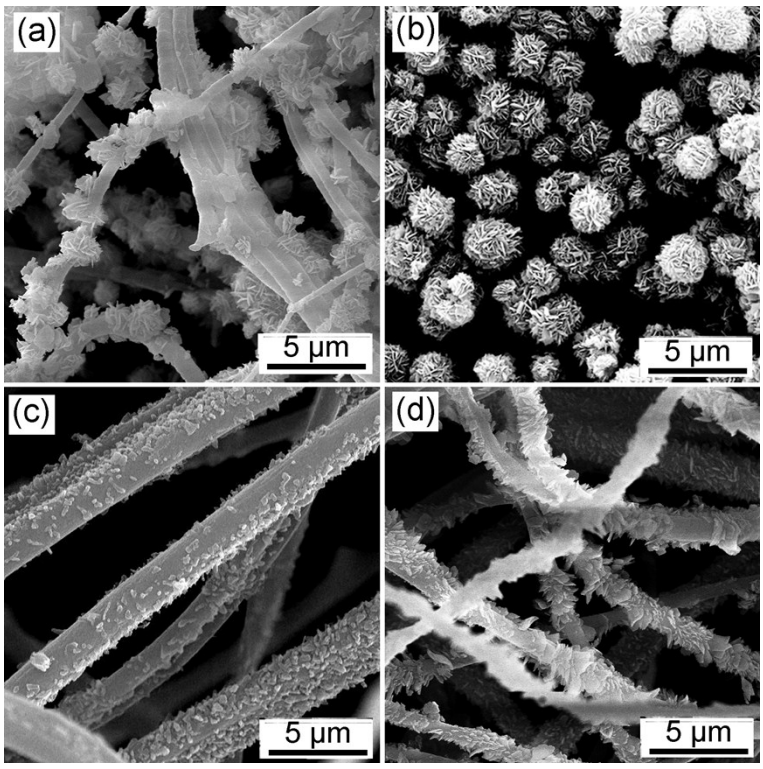

Fig. S2 SEM images of PAN/iron alkoxide nanofibers (a), flower-like iron alkoxide (b); PVA/iron alkoxide nanofibers with different reaction time: 0 min (c) and 5 min (d).

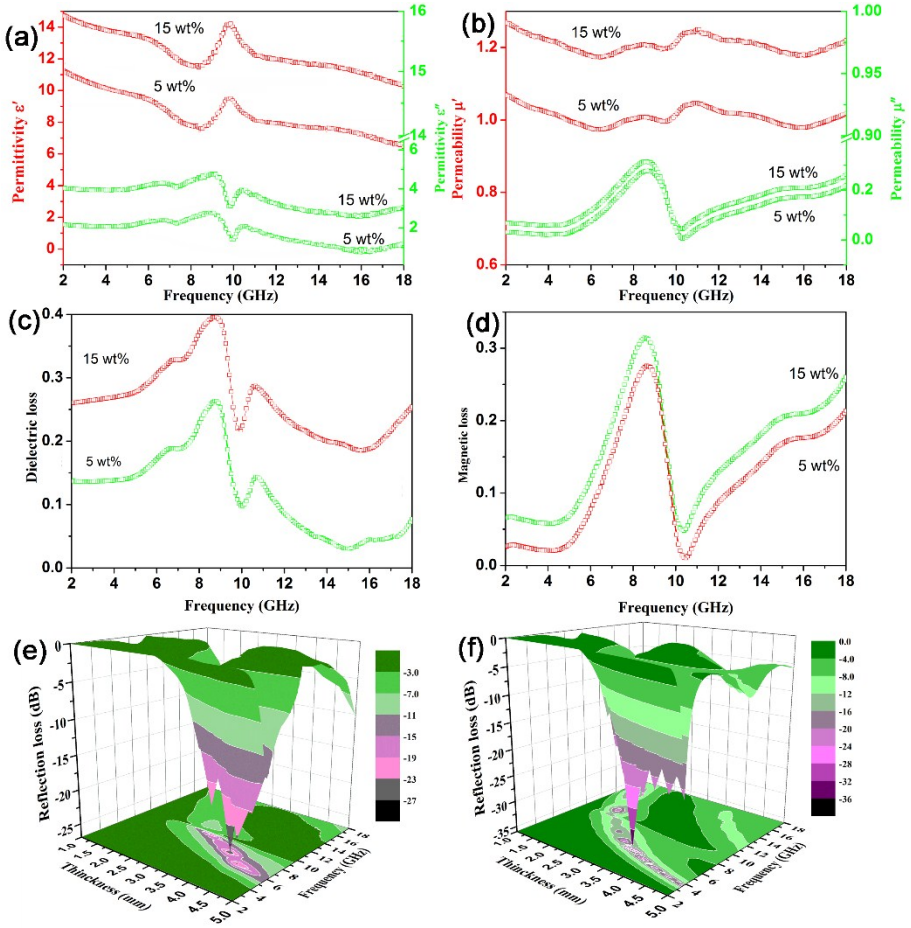

Fig. S3 Relative permittivity (a) and dielectric loss (c), relative permeability (b) and magnetic loss (d) of C/Fe_3O_4-wax composites with different loadings, and 3D representation of the R_L of C/Fe_3O_4-wax composites with loadings of 5 wt% (e) and 15 wt% (f) at thicknesses ranging from 1.0 to 5.0 mm in the frequency range 2-18 GHz.

With the increase of C/Fe_3O_4 loading (from 5 wt % to 15 wt %), significant enhancement is achieved in both real (ε′) and imaginary (ε″) permittivity (Fig. S3a). The increment of ε′ may be attributed to the fact that the increasing loading ratio of C/Fe_3O_4 increases the dipolar polarization.[1,2] Furthermore, the values of ε″ (Fig. S3a) and tan δε (Fig. S3c) both increase with the filler loading ratio. Similarly, the incresae of loading amount also leads to both real (μ_r') and imaginary (μ_r'') permeability increasing. However, not only the increase of loading amount can lead to high electromagnetic absorption. Because the frequency range is 2−18 GHz, the source-toshield distance is greater than the free-space wavelength. Thus, the measurements are considered under the condition of far field,[3] and the most effective absorption is exhibited when the impedance match between absorbers and free space is achieved.[1,4] Based on the above EM parameters at the given frequency and thickness layer, The minimum R_L value of C/Fe_3O_4 (5 wt %)−wax composites can only reach -26.9 dB with a sample thickness of 3.8 mm at 7.76 GHz (Fig. S3e). Although adding the

C/Fe_3O_4 loading (15 wt %), the minimum R_L value reach only up to -35.1 dB with a sample thickness of 3.4 mm at 5.66 GHz (Fig. s3f). Therefore adding large or small amount of absorbents is harmful to the impedance match and results in strong reflection and weak absorption.[5] In addition, the high loading of C/Fe_3O_4 in this composite can cause damage to the waveabsorption of materials, due to the occurrence of a significant skin effect when its surface is irradiated by microwave.[6]

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