Supporting Information

Preparation and Microwave absorption property of template-free graphene foam-supported Ni nanoparticles composites

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For GFN_7 and GFN_9, the 7 and 9 mean that the weight percentage contents of nickel in the GFN_7 and GFN_9 are 70% and 90%, respectively. Fig.S1 is the SEM images of GFN_7 and GFN. It is clearly seen that GFN_7 have small volume and low Ni content compared with GFN. In addition, as shown in Fig.S2, the 3D structure doesn't be kept after the hydrothermal and freeze-drying process for GFN_9. It may be caused by the excessive content of Ni. Fig.S3 displays the two-dimensional contour plots of RL versus frequency and thickness for GFN and GFN_7. It is worth noting that the bandwidth of RL<-20dB (99% absorption) of GFN is larger than that of GFN_7. And the maximum RL of GFN_7 is -41dB at 11GHz with the thickness of 3.75mm, which is weaker than that of GFN (-49dB). Hence, the GFN is used to compare with other specimens and research the mechanism of microwave absorption in this work.

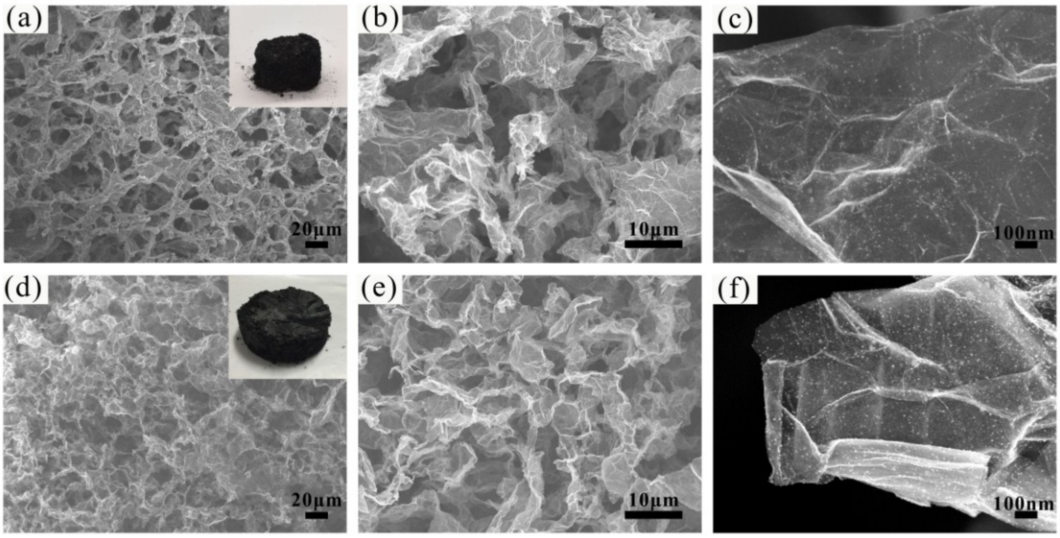

Fig. S1 SEM images of (a-c) GFN_7, (d-f) GFN

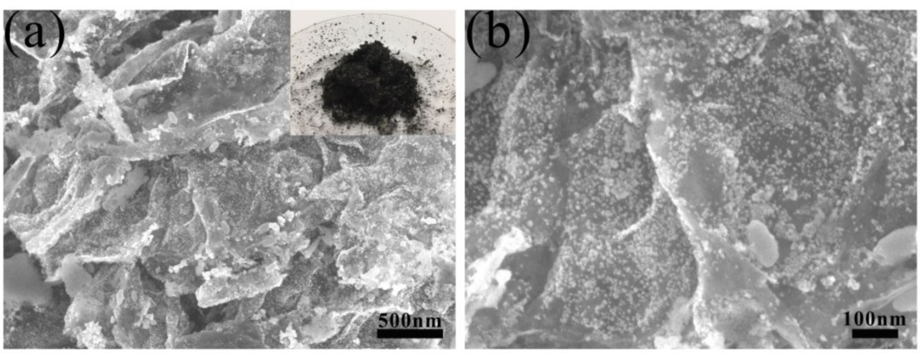

Fig.S2 SEM images of GFN_9

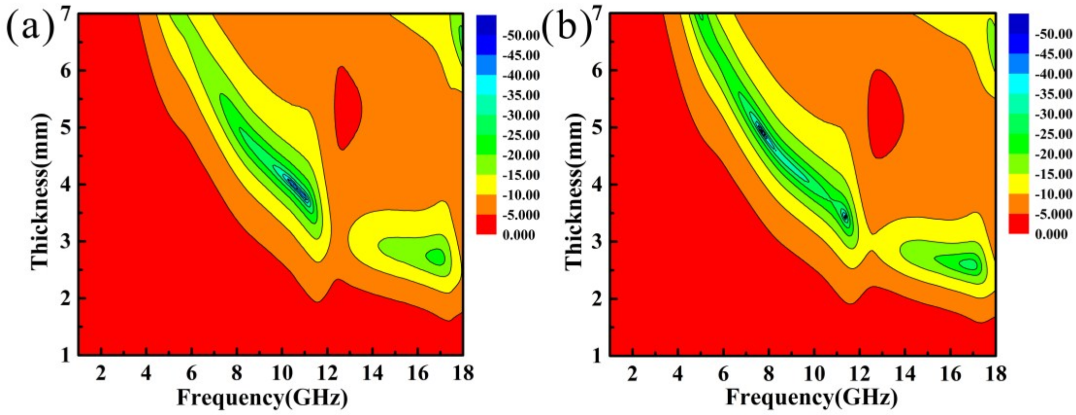

Fig. S3 Contour maps of RL versus frequency and thickness for GFN_7 and GFN

Fig. S4 shows the XRD patterns of Ni nanoparticles, $Ni(OH)_2$ nanoparticles and the graphene-supported $Ni(OH)_2$ nanoparticles composites (GFNH) composite according to the synthetic route mentioned in the experimental section. The peaks of GFNH composite match well with the characteristic peaks of the hexagonal theophrastite in the range of 10-80˚ corresponding to the standard card no. 14-0117, and the broad peak at around 25.6º corresponds to the characteristic diffraction peak (002) of rGO. After calcination of synthetic $Ni(OH)_2$ nanoparticles at the H_2/Ar atmosphere, the XRD pattern of calcinated specimen shows high degree of crystallinity and can be readily indexed to the face-centered cubic Ni phase (JCPDS card no. 87-0712).

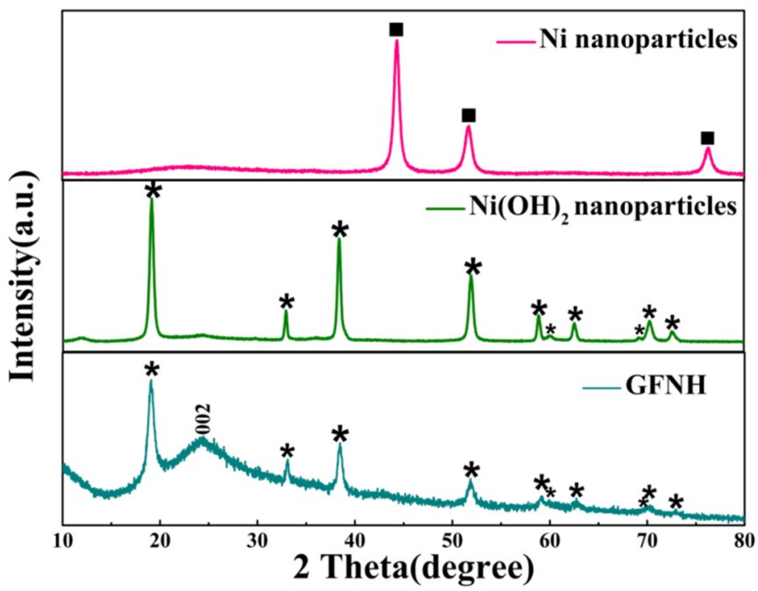

Fig.S4 XRD patterns of Ni nanoparticles, $Ni(OH)_2$ nanoparticles and GFNH

The magnetic hysteresis loops of GFNO and GFN are measured at room temperature using the vibrating sample magnetometer (VSM), as shown in Fig. S5. The hysteresis loop of GFN reveals that it's a typical soft magnetic material and has strong ferromagnetic nature. The saturation magnetization (M_s) of GFN is 12.5emu/g and far less than that of bulk nickel (55emu/g) due to the small particle size and the presence of non-magnetic graphene foam.[1] The remanent magnetization (M_r) and coercivity (H_c) of GFN are 1.99emu/g and 103Oe, respectively. Soft magnetic materials possess the characteristics of easy magnetization and demagnetization, and could convert electromagnetic energy into heat energy, which is beneficial to scatter the microwave.[2] However, as shown in the inset of Fig. S5, the M_s, M_r and H_c of GFNO composite are 4.85×10^{-4} emu/g, 5.15emu/g and 154Oe, respectively. The result indicates that GFNO shows superparamagnetism and weak ferromagnetism in room temperature, as well as the contribution towards the magnetic moment arising from other sources such as the presence of non-stoichiometry and/or Ni^{3+} ions. [3-5]

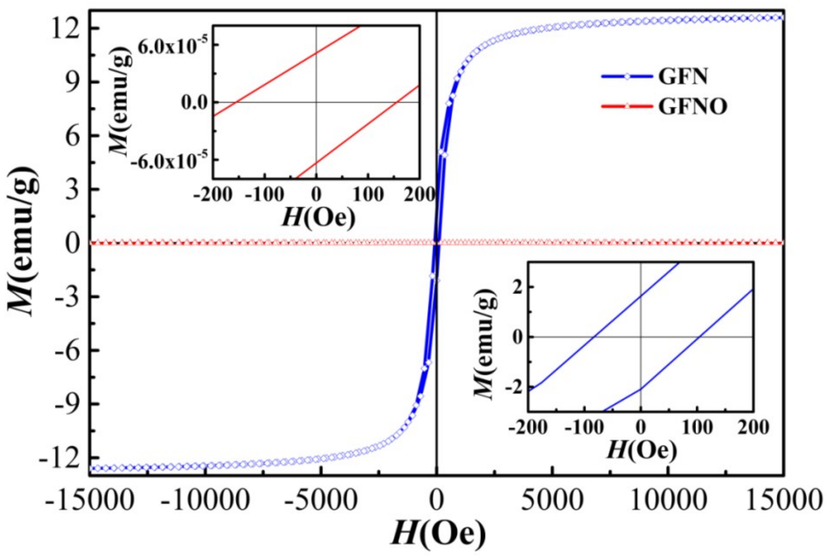

Fig. S5 Hysteresis loops of the GFN and GFNO measured at room temperature

Notes and references

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