Fe₃O₄ nanoparticles decorated on CuS platelets based sphere: A popcorn chicken-like heterostructure as an ideal material against electromagnetic pollution

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In Fig. S1a-c, different magnification TEM images of Fe₃O₄ NPs were displayed. It is visible that Fe₃O₄ NPs possess a relatively uniform spherical in shape with the diameters distribution in the range of 250-300 nm. The high magnification TEM image (Fig. S1c) demonstrates that the rough surfaces of Fe₃O₄ NPs are caused by the formation of lots of small primary nanocrystals. Fig. S1d shows that the morphology of the pristine CuS reveals a flower-like structure with the diameter about 3 µm, and these the flower-like structured pristine CuS composed of thin nanoflakes disorderly with the average thickness of about 10 nm. This unique structure endows the CuS with the specific surface area and it is noticed that interspace between the nanoflakes can be a suitable position for generating bond with the Fe₃O₄ NPs.

**Fig. S1** Different magnification TEM images of Fe₃O₄ NPs (a - c) and SEM image of pristine CuS (d).

The EA properties of the composites is also determined by the loss tangent of electricity \( \tan\delta_\varepsilon = \varepsilon''/\varepsilon' \) and magnetism \( \tan\delta_\mu = \mu''/\mu' \). The loss tangent can be calculated based on the data in Fig. 7, and the results are shown in Fig. S3. We extract the following observations: The frequency dependence of the \( \tan\delta_\mu \) exhibits very similar variation trend, while the \( \tan\delta_\varepsilon \) of 40 wt% CSF filler loading displays a larger value than the other two samples. In this regard, the dielectric loss rather than the magnetic loss...
contributes mainly to the EA of this sample.

**Fig. S2** Frequency dependence of the dielectric loss tangent (a) and magnetic loss tangent (b) of CSF-160 heterostructure with the filler loading of 30 wt%, 40 wt% and 50 wt%.

Table 1†, we summarized the EA performances of some other CuS-based materials which have been published in recent years. The above results indicate that the as-prepared popcorn chicken-like CSF displays the strongest absorption properties and a broader absorption bandwidth with a thin absorber thickness (1.5mm).

**Table 1†** EA performance of typical CuS based composites reported in this work and recent literatures (PVDF: polyvinylidene fluoride)

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<tr>
<th>Filler</th>
<th>Matrix</th>
<th>Optimal RL (dB)</th>
<th>Efficient EA bandwidth (GHz)</th>
<th>Thickness (mm)</th>
<th>Ref.</th>
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<tr>
<td>CSF-160</td>
<td>Wax</td>
<td>−61.32</td>
<td>4.15</td>
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<td>RGO/CuS</td>
<td>PVDF</td>
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References


