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Organic-Inorganic Hybrids Reinforced Flexible and Robust 2D Papers for High-efficiency Microwave Absorbing Films

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Fabrication of testing CGP samples: For the fabrication of wax|CGP|wax structures, liquid wax was previously prepared with continuous base heating. The entire preparation process was carried out in the in a grinding cutter with standard toroidal shape (inner diameter of 3.04 mm, outer diameter of 7 mm). Firstly, a certain amount of tightly stacked CGP papers (the same cross section as the standard toroidal shape) were filled into the gap of grinding cutter. Then, liquid paraffin was poured into the grinding cutter, making full contact with the pre-added CGP papers. Finally, when the liquid paraffin was solidified, subtle treatment was conducted to obtain a standard testing sample with wax|CGP|wax structures. It is worth noting that, in order to maintain the mass fraction of paper sample to paraffin as 7:3, the addition of CGP paper and liquid wax were both previously calculated. Similarly, the other testing samples with different mass ratio can also be prepared by controlling the addition of CGP paper and liquid wax. For the convenience of contrast experiment, thickness of all the testing samples were kept as 2 mm.

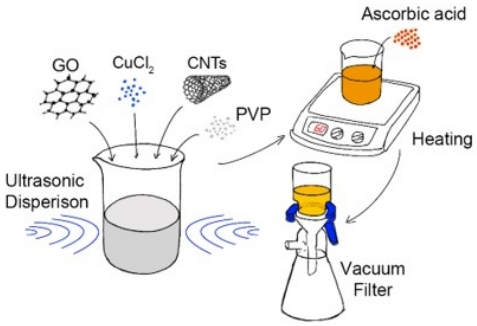

Fig. S1 Schematic illustration of the synthesis process of CGP samples.

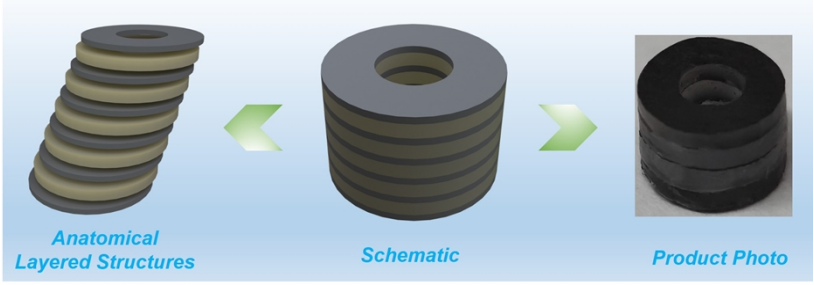

Fig. S2 Scheme of layered wax|CGP|wax testing sample and the product photo.

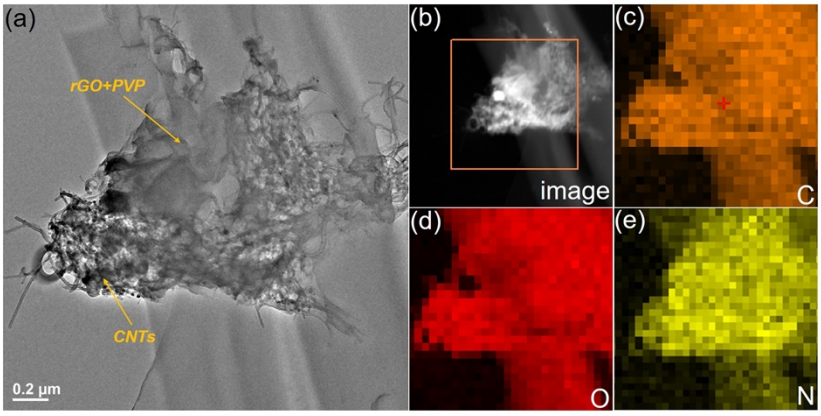

Fig. S3 TEM images of CGP2 samples at different magnification.

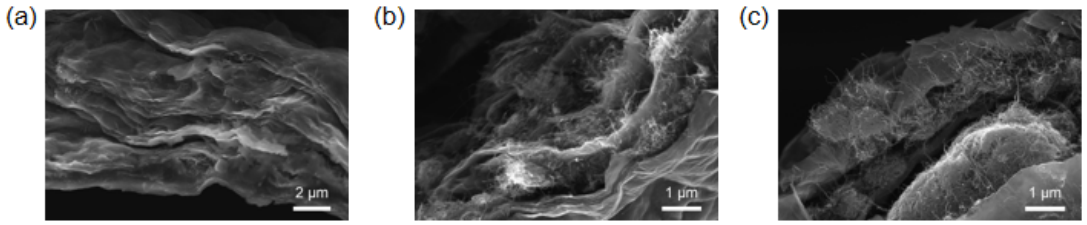

Fig. S4 SEM images of (a) CGP1, (b) CGP2 and (c) CGP3 samples without the addition of PVP.

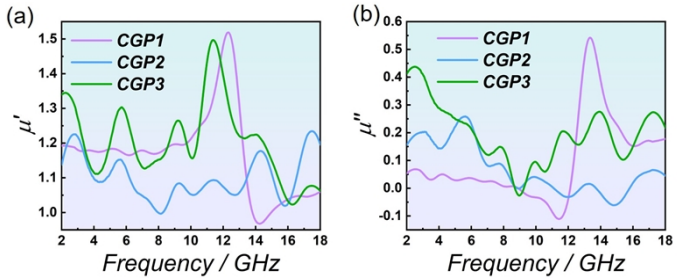

Fig. S5 (a) Real part and (b) imaginary part of complex permeability of three CGP samples.

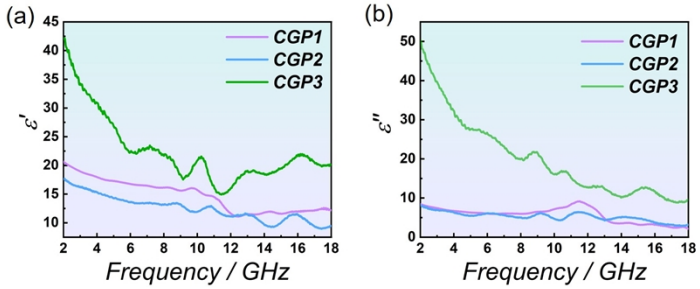

Fig. S6 (a) Real part and (b) imaginary part of complex permittivity of three CGP samples.

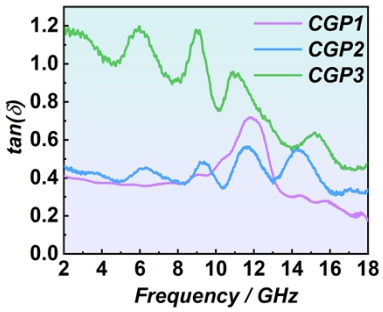

Fig. S7 Dielectric loss tangent of three CGP samples.

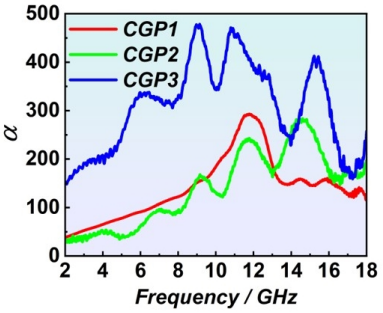

Fig. S8 Attenuation constant (α) of CGP samples.

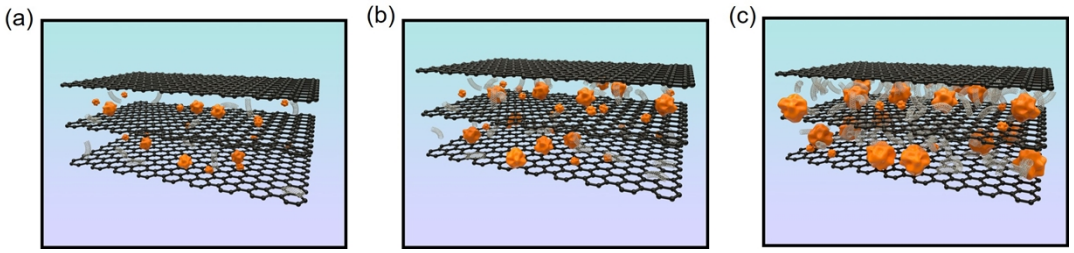

Fig. S9 Schematic illustration of the composition of the (a) CGP1, (b) CGP2 and (c) CGP3 samples.

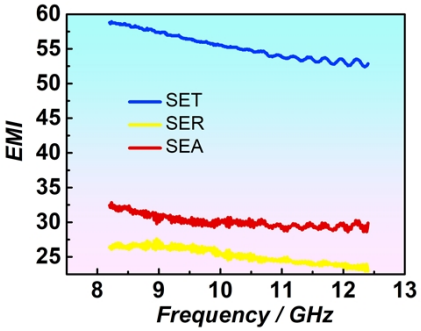

Fig. S10 EMI shielding performance of CGP3 samples.

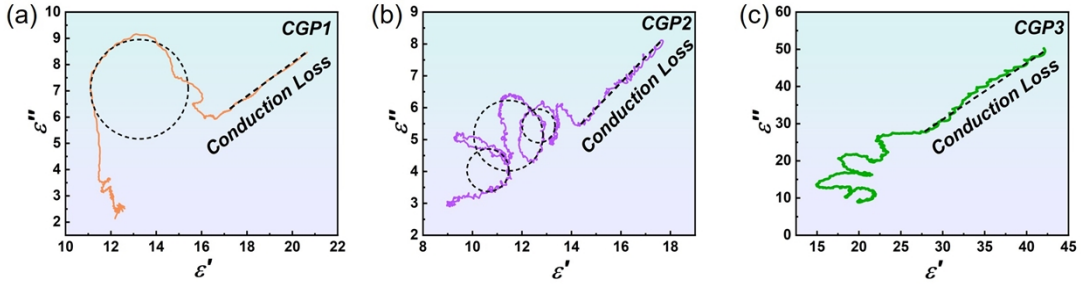

Fig. S11 Cole−Cole plots of (a) CGP1, (b) CGP2, and (c) CGP3 samples.

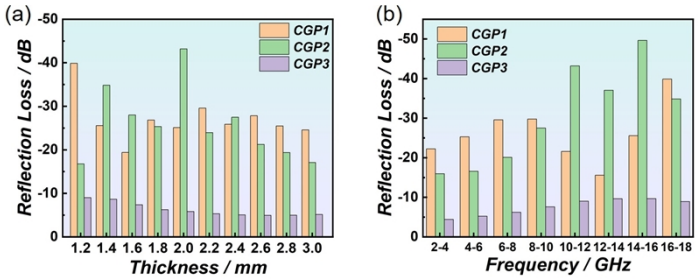

Fig. S12 Comparison of RL values at different (a) thickness and (b) frequency interval.

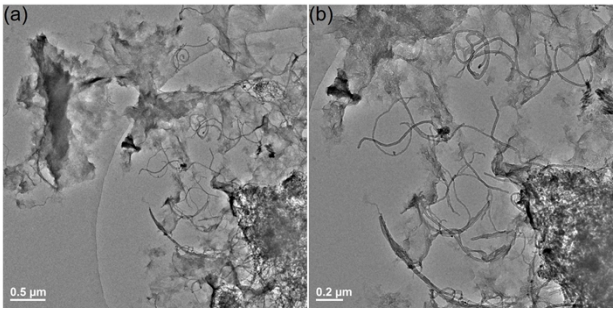

Fig. S13 TEM images of samples with random mixture of CNTs, rGO and PVP.

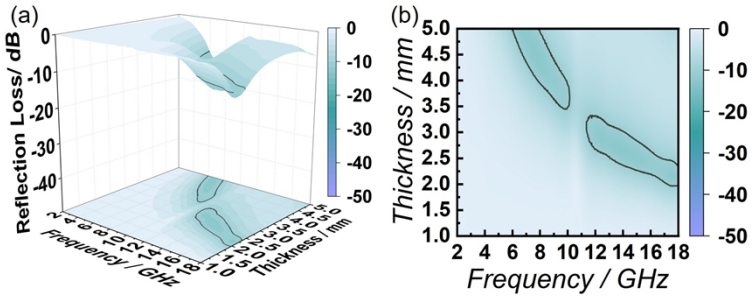

Fig. S14 Microwave absorption performances of samples with random mixture of CNTs, rGO and PVP.

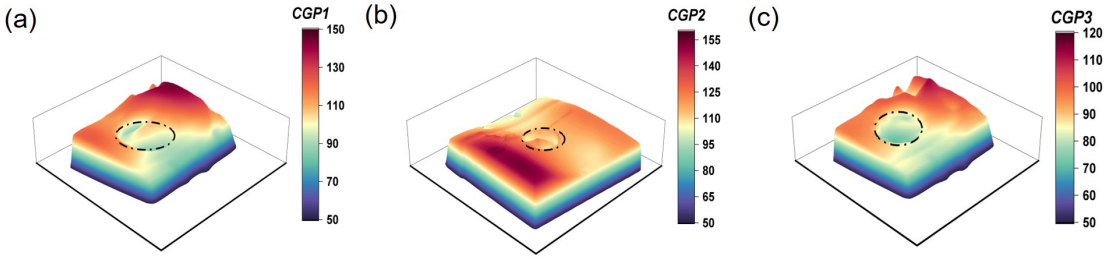

Fig. S15 3D thermal imaging of (a) CGP1, (b) CGP2 and (c) CGP3 samples.

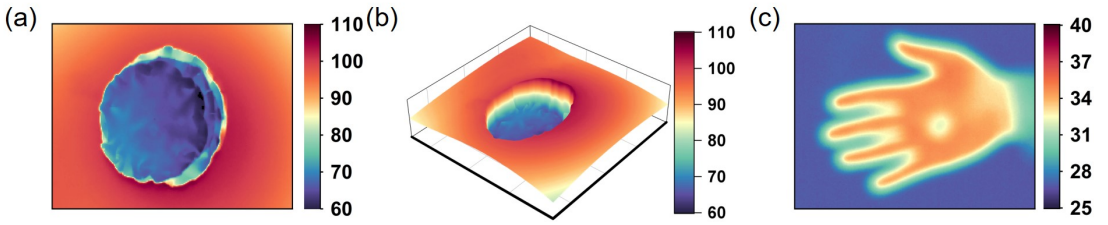

Fig. S16 (a) 2D and (b) 3D thermal imaging figure of CGP2 sample stacked about 100 μm. (c) 2D thermal imaging of CGP2 on human hand.

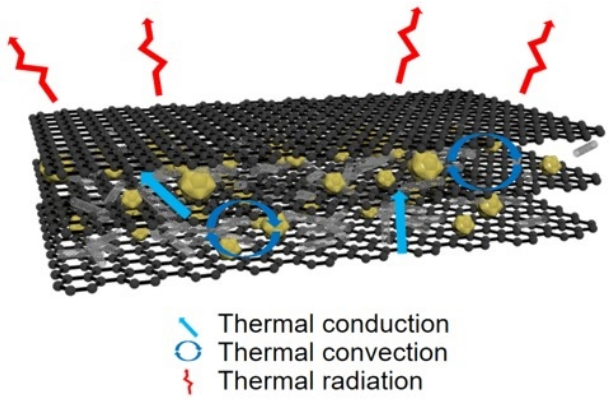

Fig. S17 Schematic illustration of the heat transfer mechanism.