Supporting Information

Composite with Gradient Distribution of Graphene and Its Anisotropic Electromagnetic Reflection

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METHODS AND MEASURMENTS

Preparation of rGO/PU composite with gradient rGO distribution: Graphene oxide was obtained by harsh oxidation of graphite according to the modified Hummers' method. In a typical gradient rGO/PU composite preparation process, 100 μL concentrated NH_3 solution was added into 20 mL GO solution (4 mg/mL), and then a commercial PU foam (9 mL) was immersed into it by squeezing to sure that the solution fully went into the foam. Then the PU foam filled with GO solution was placed into the electrophoresis apparatus designed by ourselves (Figure S1) and a voltage of 30 V was applied to the electrodes. After electrophoresis for 4 min, the foam was immediately immersed into diluted HCl solution (0.12 mol/L) for 1 hour and then dried at 80℃ in oven for 6 hours. As-synthesized GO/PU composite foam was immersed into the hydrazine solution (1.3 mol/L) and then transferred into a teflon-lined stainless steel autoclave heated at 100℃ for 5 hours. After the reduction, the rGO/PU composite was washed with water for several times and dried at 80℃ in oven for 6 hours.

Preparation of rGO/PU composite with uniform rGO distribution: In a typical uniform rGO/PU composite preparation process, PU foam (9 mL) was immersed into GO solution (4 mg/mL). Then the PU foam filled with GO solution was placed into diluted HCl solution (0.12 mol/L) for 1 hour and then dried at 80℃ in oven for 6 hours. As-synthesized GO/PU composite

foam was immersed into the hydrazine solution (1.3 mol/L) and then transferred into a teflon-lined stainless steel autoclave heated at 100℃ for 5 hours. After the reduction, the rGO/PU composite was washed with water for several times and dried at 80℃ in oven.

Characterization and measurement: Raman spectra were obtained under ambient conditions with a LabRAM micro-Raman spectrometer equipped with a 473 nm wavelength excitation laser. Thermogravimetric analysis (TGA) was carried out with a TGA type instrument (Mettler Toledo) from 30 to 800 ℃ with a heating rate of 10 ℃/min in Ar. The morphology of composite foams was observed by scanning electron microscopy (SEM, Hitachi S-4800). The scattering parameters were measured on a vector network analyser (Agilent N5230C) at room temperature in X-band (8-12 GHz) by the waveguide method, and the frequency region has been divided in 201 frequency steps. The rGO/PU composite foams with a thickness of 20 mm were cut to cubes with the length and width of 22.5 mm and 10 mm to fit an aluminium waveguide, and the samples were placed into the middle of the waveguide fitted into the test fixture for the two-port measurement (Figure S2).

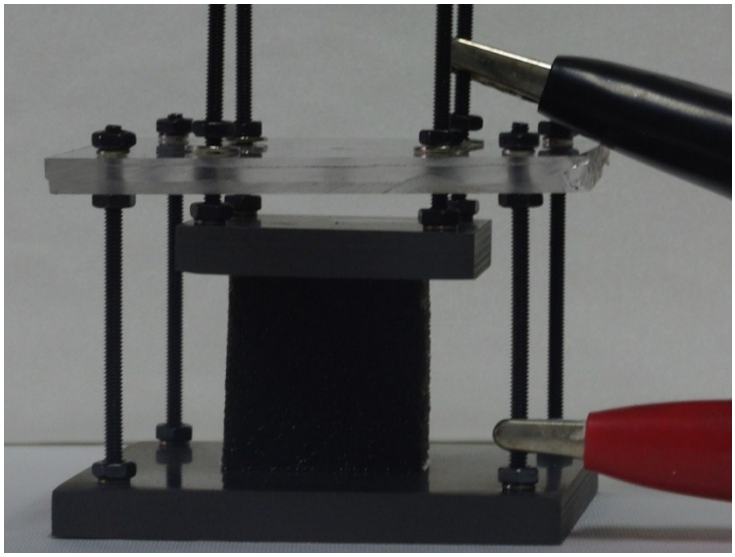

Figure S1. The optical image of equipment for the electrophoretic treatment of PU foam filled with GO solution.

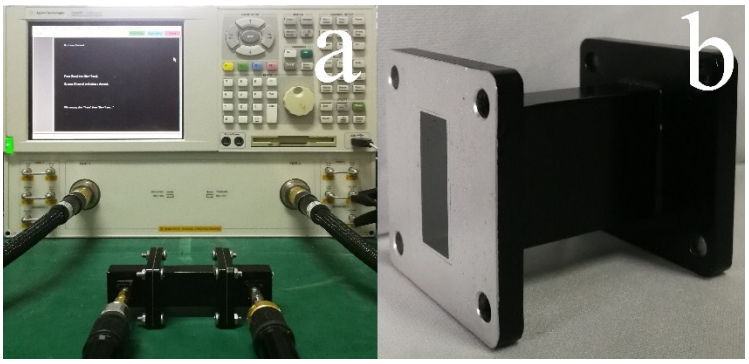

Figure S2. Photographs of the electromagnetic testing device (a), and the aluminium waveguide used to place the samples in the middle part of the cavity (b).