Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

In Situ Growth and Pyrolysis Synthesis of Super-hydrophobic Graphene Aerogels Embedded with Ultrafine β-Co Nanocrystals for Microwave Absorption

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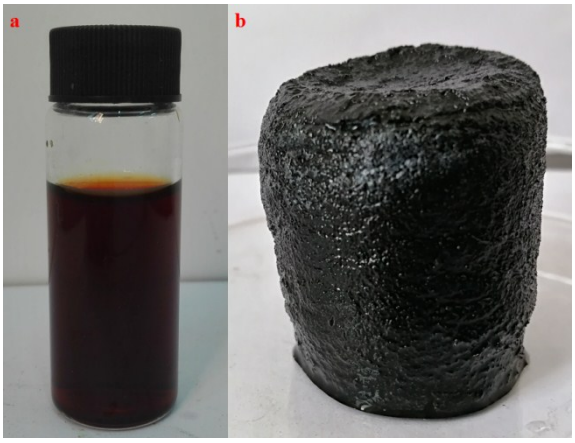

Fig. S1 Typical digital photograph of (a) GO suspension, (b) macroscopic photographs of rGO/AACo/PVA hydrogel

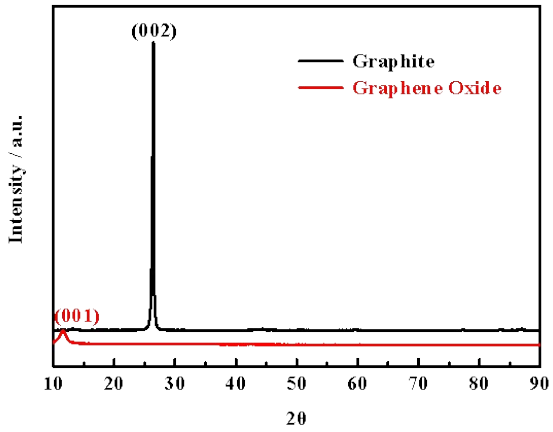

Fig. S2 XRD patterns of graphite and the as-synthesized sample of GO.

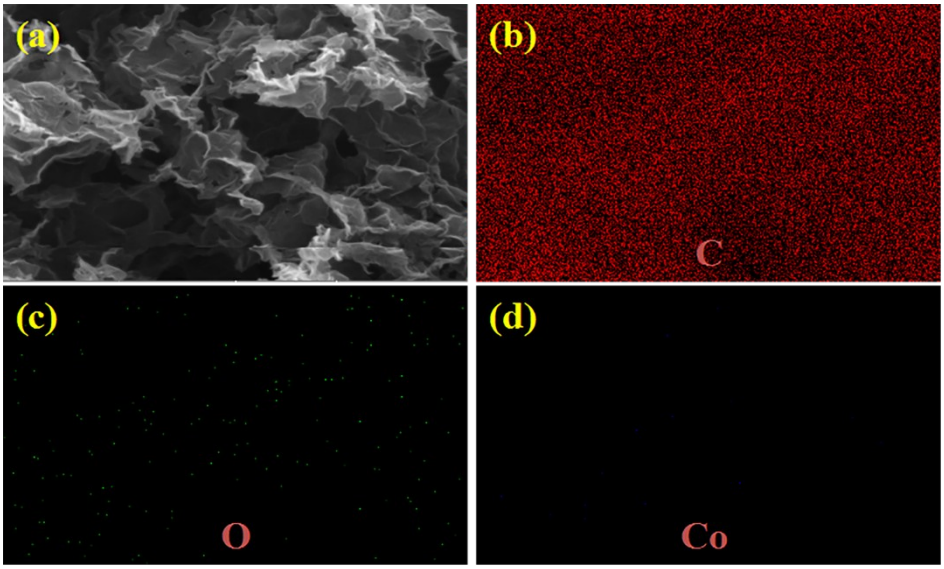

Fig. S3 SEM/EDS elemental mapping images of (b) C, (c) O and (d) Co.

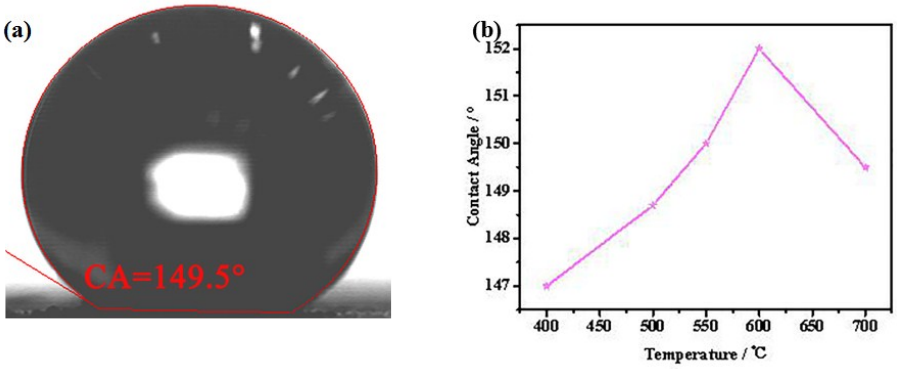

Fig. S4 (a) Water contact angle of SMGA-Co at calcination temperature of 700 ℃.

(b) Water contact angles of SMGA-Co at different calcination temperatures.

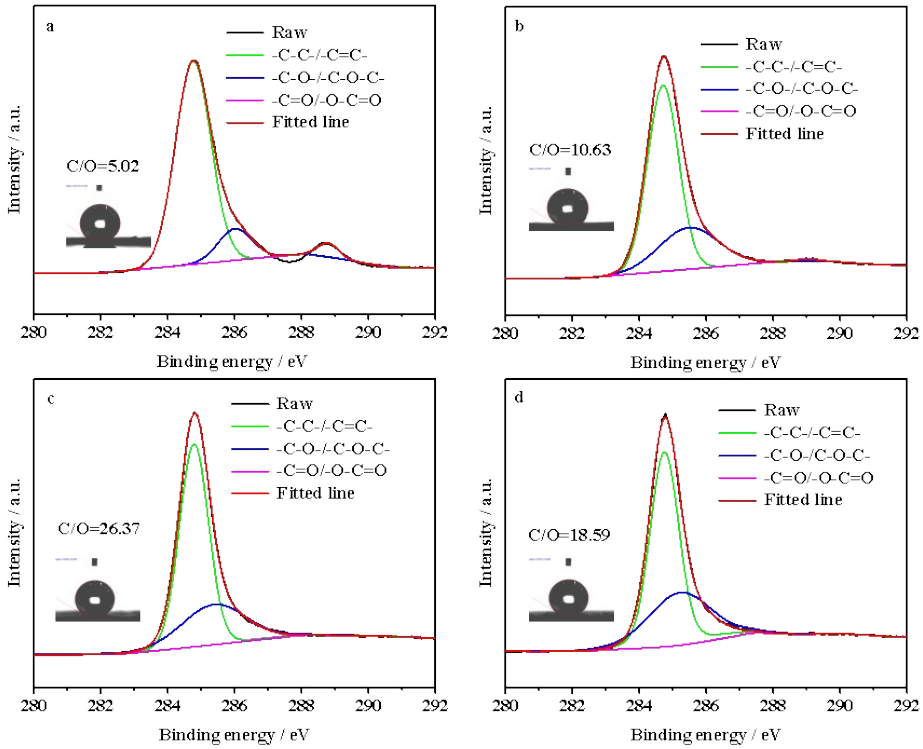

Fig. S5 C 1s XPS spectra of SMGA-Co at different annealing temperatures:(a) 400℃,(b) 500℃, (c) 600℃,(d) 550℃.

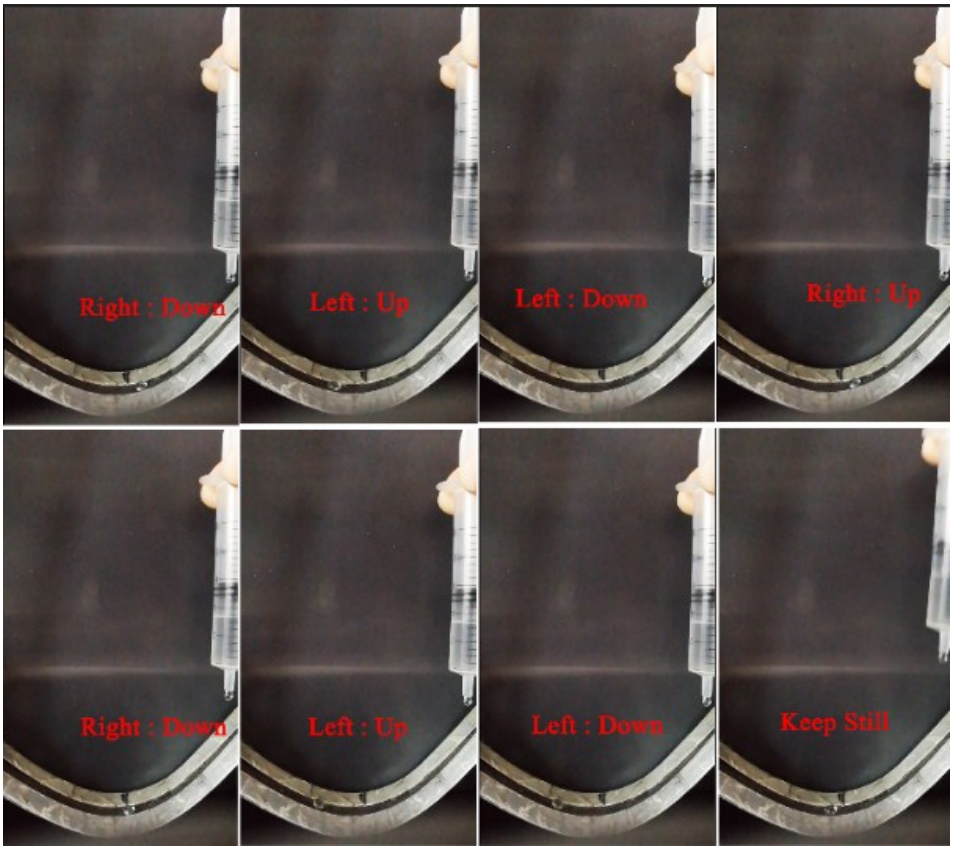

Fig. S6 Water droplet sliding on a homemade U-shaped trajectory, which is fabricated by anchoring the SMGA-Co nanocomposites on a flexible aluminum substrate.

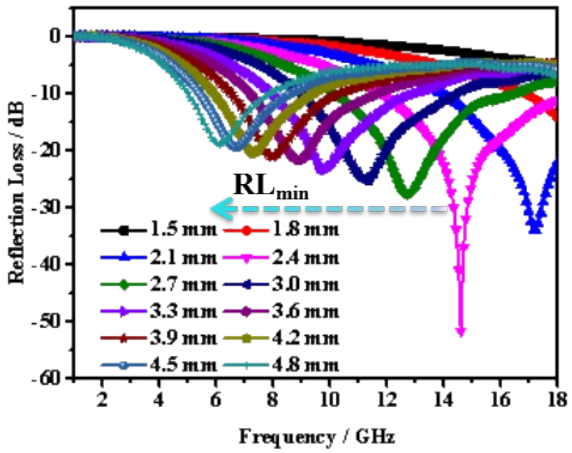

Fig. S7 Reflection loss values of SMGA-Co at different thicknesses.

Table S1 Computation of atom ratio for Graphite, GO, GA and SMGA-Co.

	I_D/I_G	C/O (at.%)
Graphite	0.76	---
GO	1.38	72.9/27.1 (2.69)
SMGA-Co	1.79	94.44/5.08 (18.59)
GA	1.85	95.12/4.88 (19.49)

Table S2: Typical Co-based and graphene-based composites for MA performance in open literatures

Samples in matrices	wt %	Max |RL| [dB]	Thickness [mm] (RL ≤ -10 dB)	Testing frequency range [GHz]	Frequency range [GHz] (RL ≤ -10 dB)	Refs
SMGA-Co composites in paraffin	4.25	-51.6	2.4	1-18	11.5-18	This work
Co/CNT/Graphene	30	-65.6	2.19	2-18	10-13	[1]
Co/GN nanocomposites	60	-47.5	2.0	1-18	------	[2]
Co@CoO	50	-90.2	1.3	2-18	12-15.5	[3]
Co/C	30	-40	5.0	2-18	------	[4]
Co dendrites	65	-35.6	3.0	1-18	10.5-14.5	[5]
Co-CoO composites	60	-30.5	1.7	2-18	12.6-17.3	[6]
$Co_xFe_{3-x}O_4$ spheres	75	-41	2.0	2-18	X band	[7]
$CoFe_2O_4$ hollow sphere/graphene	60	-18.5	2.0	1-18	11.3-15	[8]
Porous Fe_3O_4-decorated graphene	30	-44.2	3.0	0.5-18	4.1-6.8 16.0-17.8	[9]
RGO-Fe_3O_4	40	-15.4	2.0	0.5-18	10.4-13.2	[10]
GO/CNT-Fe_3O_4	30	-37.3	5	2-18	<1	[11]
Ni-graphene	20	-13	2.0	2-18	9.6-12.2	[12]
Thermally reduced graphene	1	-43.5	3.5	2-18	9.4-16.8	[13]
graphene/SiO_2	7	-42	2.1	X-band	8.4-12	[14]
3D Graphene-Ni	33	-59.7	2.7	1-18	9.4-14.2	[15]
rGO/a-Fe_2O_3 composite	8	-33.5	3.0	1-18	10.8-17.2	[16]
Fe_3O_4/GCs Composites	30	-32	3.5	2-18	6.9-11.9	[17]

Table S3 The conductivity and resistivity of different samples

sample	Graphene oxide	graphene	Graphene aerogels	SMGA-Co
σ (S/m)	0.0150	0.0880	0.0145	0.0731
ρ (Ω•m)	66.7	11.4	69.0	13.7

Supplementary Notes

Supplementary Note S1: the integral area (∆*S*) and the microwave absorption efficiency (R_E)

Maximum reflection loss (*RL*) and effective absorption bandwidth (*EAB*) are two parameters to assess the microwave absorption properties. The corresponding thicknesses are not consistent, however, the data are not comparable. Hence, it is difficult to judge which thickness is the appropriate absorber thickness to obtain the best microwave absorption properties. Thus, we use the integral area (∆S when RL value is below -10 dB) to determine microwave absorption performance. We define ∆*S* as equal to the integral area when *RL* < -10 dB. Then the microwave absorption efficiency (R_E) is defined as $R_E = \Delta S / d$.

Supplementary Note S2: Basic concepts of impedance matching ratio (Z) and attenuation constant (α).

The enhanced microwave absorption properties mainly resulted from the impedance matching Z and attenuation constant α, as expressed by the following equation:

$$\alpha = \frac{\sqrt{2}\pi f}{c} \times \sqrt{(\mu''\varepsilon'' - \mu'\varepsilon') + \sqrt{(\mu''\varepsilon'' - \mu'\varepsilon')^2 + (\mu'\varepsilon'' - \mu''\varepsilon')^2}} \quad (1)$$

$$Z = \sqrt{\sqrt{(\mu''^2 + \mu'^2)} / \sqrt{(\varepsilon''^2 + \varepsilon'^2)}} \quad (2)$$

Where *f* and c are the frequency of the electromagnetic wave and the velocity of light, respectively.

The incident electromagnetic wave irradiates on the surface of the materials from free space, reflection and transmission phenomena will happen at the interfaces. In order to realize the efficient absorption of electromagnetic waves, it is important to make electromagnetic waves through the material surface as much as possible. Then, the absorption materials could effectively attenuate electromagnetic waves by converting them into thermal energy or dissipating them through interference. The impedance match requires that the relation between permittivity and permeability tends to be close, which can achieve zero-reflection at the front surface of the materials.

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