Supporting Information

Facile fabrication of ultra-light and highly resilient PU/RGO foams for microwave absorption

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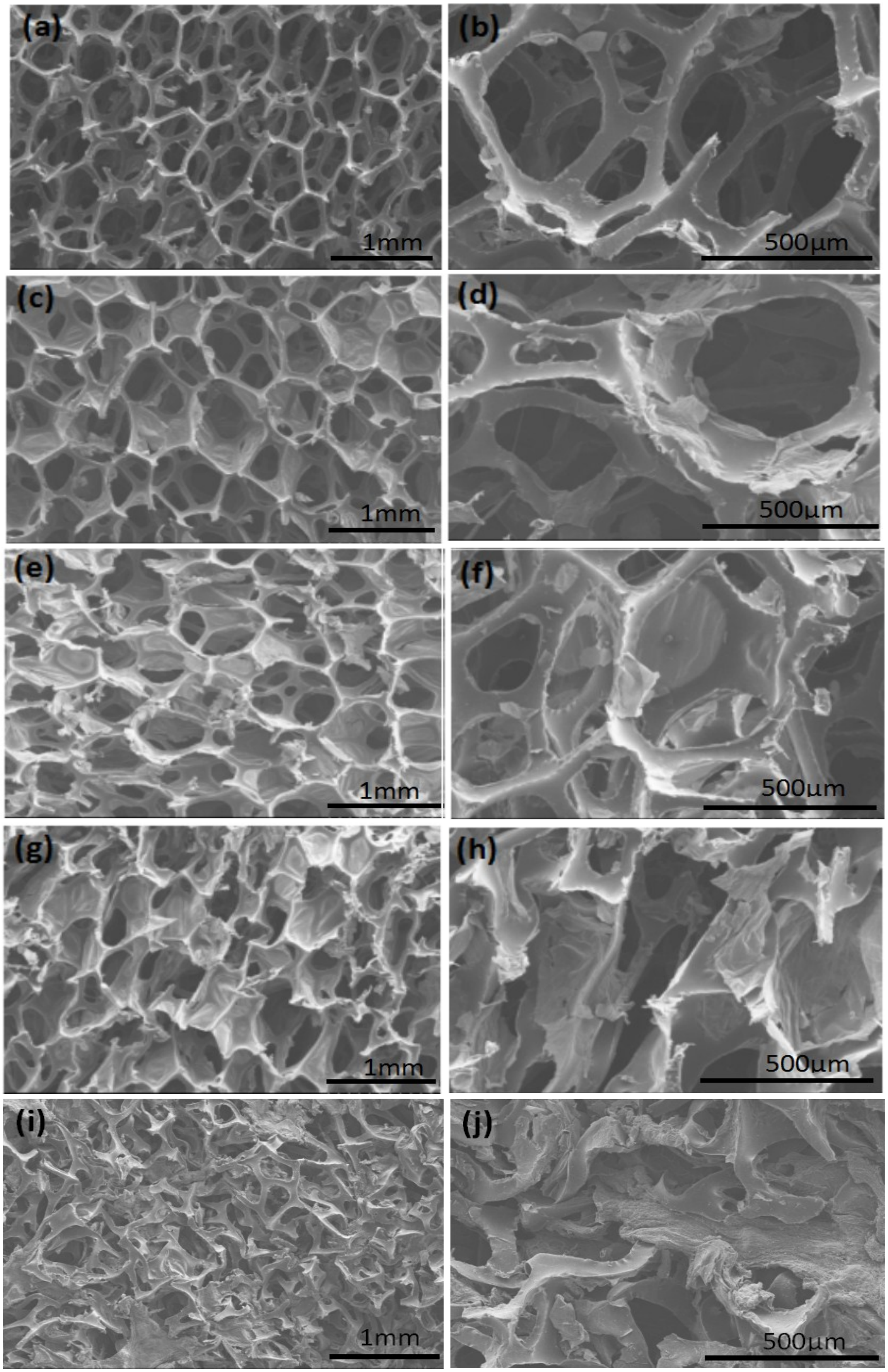

Figure S1 SEM images of PU/RGO foams with different loadings of RGO: (a) and (b) sample S-3, (c) and (d) sample S-6, (e) and (f) sample S-9, (g) and (h) sample S-12, and (i) and (j) sample

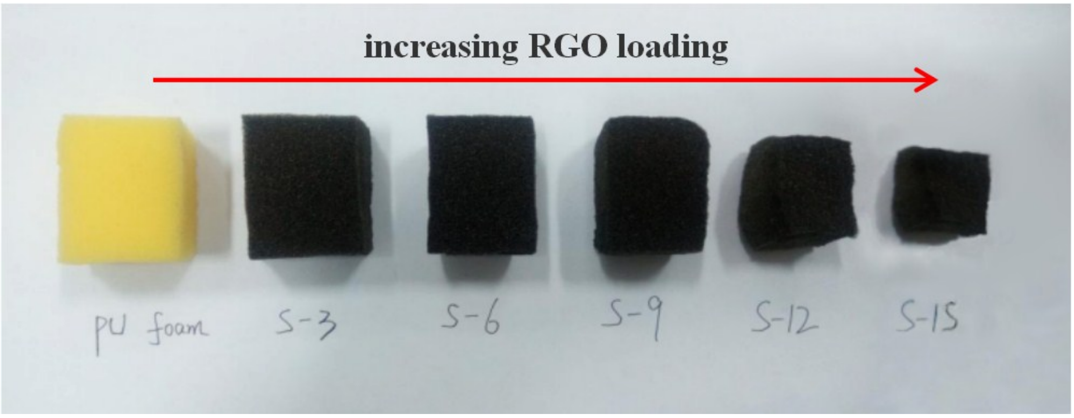

Figure S2 The photos of the PU foam and the prepared PU/RGO foams with different RGO loadings

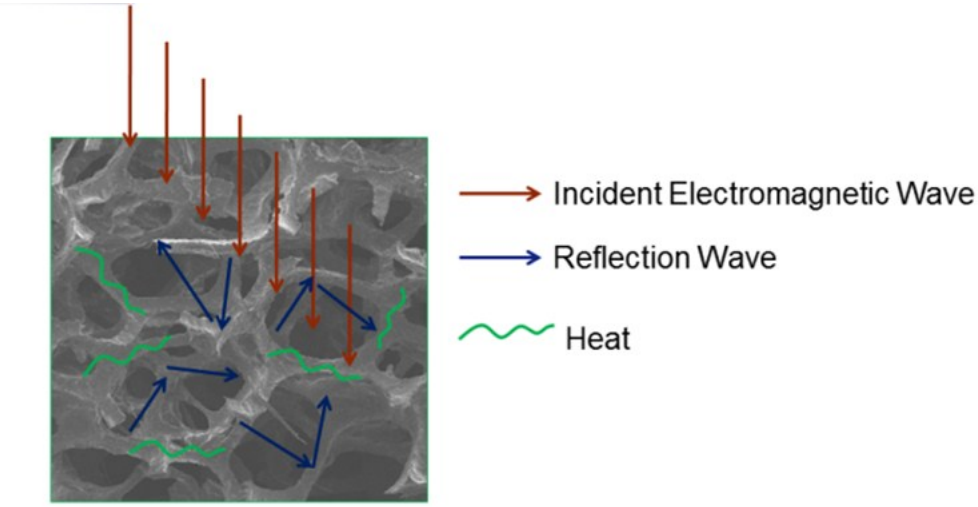

Figure S3 Schematic illustration of the dissipation routes of microwaves irradiated in the PU/RGO foams

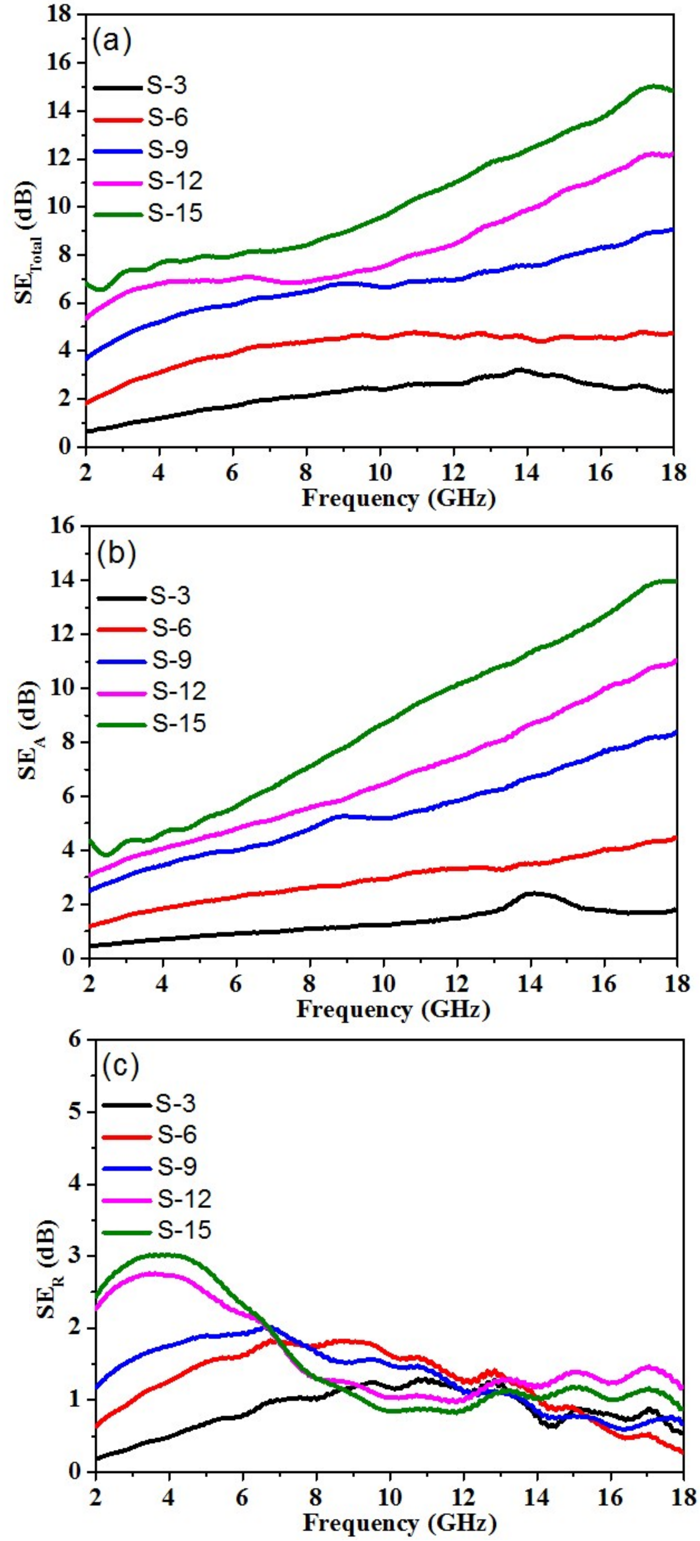

Figure S4 The variation curves of (a) SE_{Total}, (b) SE_A, and (c) SE_R of samples with different RGO loadings in the frequency range of 2 - 18 GHz

The samples used for electromagnetic shielding performance measurements were made into toroidal-shaped specimens with an outer diameter of 7.0 mm and an inner diameter of 3.04 mm. The values of S parameters were measured in the frequency range of 2–18 GHz with a thickness of 4 mm by using a vector network analyzer (Agilent, 85050D) for further calculation.

From the measured scattering parameters, the power coe□cients of reflectivity (R), transmissivity (T), and absorptivity (A) can be calculated. The EMI SE is the sum of the reflection from the material surface (SE_R), the absorption of electromagnetic energy (SE_A), and the multiple internal reflections (SE_M) of electromagnetic radiation. The reflection is related to the impedance mismatch between air and absorber; the absorption can be regarded as the energy dissipation of the electromagnetic microwave in the absorber; and the multiple reflections are considered as the scattering effect of the inhomogeneity within the materials [1-3]. The attenuation caused by multiple reflections can be ignored when shielding caused by absorption is greater than 10 dB, which indicates that most of the re-reflected wave will be absorbed within the shield.

The SE_{Total}, SE_A and SE_R are expressed in dB, and can be calculated by using Equations:

$$R + T + A = 1 \tag{1}$$

$$R = |S_{11}|^2 \tag{2}$$

$$T = |S_{21}|^2 \tag{3}$$

$$SE_A = -10\log(\frac{T}{1-R}) \tag{4}$$

$$SE_R = -10\log(1-R) \tag{5}$$

$$SE_{total} = -10\log(P_t / P_i) = SE_A + SE_R + SE_M \tag{6}$$

in which P_i and P_t are the incoming and transmitted powers of electromagnetic waves [4,5].

The variation curves of SE_{Total}, SE_A and SE_R of composites with different RGO loadings in the frequency range of 2 - 18 GHz are shown in Figure S4. It can be seen that the values of SE_A and SE_{Total} increase with frequency, and moreover, with increasing RGO content, the values of SE_A and SE_{Total} are improved correspondingly, which is similar to the relationship between electrical conductivity and filler content and is consistent with the EMI shielding theory [6-9]. The SE_{Total} values of samples S-3, S-6, S-9, S-12, and S-15 are 0.63-3.24, 1.82-4.79, 3.67-9.04, 5.34-12.22 and 6.54-15.03

respectively. Sample S-15 exhibits the best electromagnetic shielding performance, which is due to the improved conductivity with increasing RGO loading. For the composite foam S-12, the values of SE_{total}, SE_A, and SE_R at 10 GHz are 7.48, 6.45 and 1.03 dB respectively, confirming that microwave absorption is the dominant contribution to the total EMI SE of the PU/RGO foams. We suggest that the two-dimensional structure of graphene as well as the large surface area and interface area in PU/RGO foam composites are beneficial for the multiple reflection of the incident microwaves inside the foam composites and consequently responsible for the absorption-dominant EMI shielding [2,3,8].

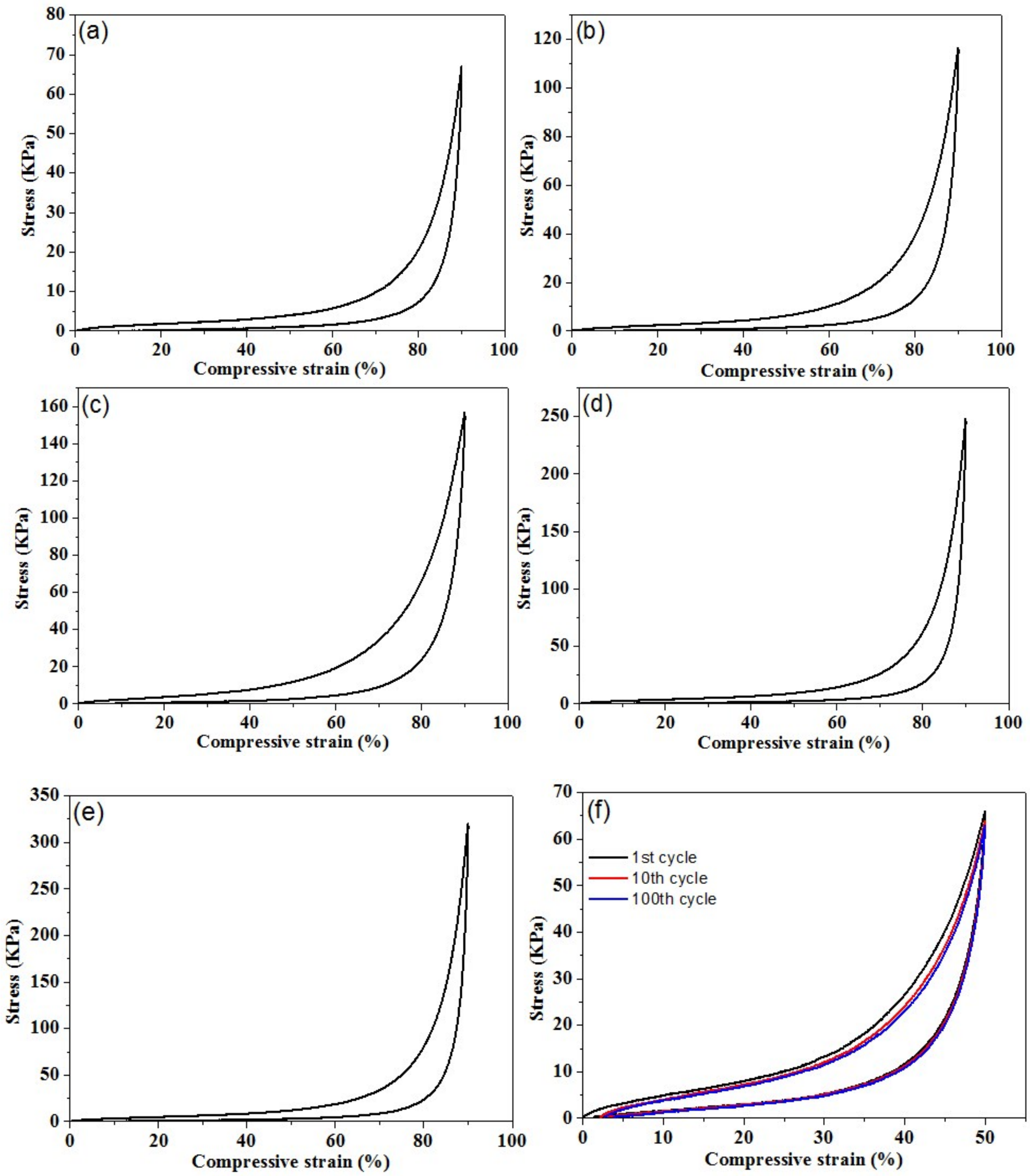

Figure S5 The stress-strain curves of PU/RGO foams with different RGO loading levels at a strain of 90%: (a) sample S-3, (b) sample S-6, (c) sample S-9, (d) sample S-12, and (e) sample S-15. (f) The cyclic stress-strain curves of sample S-15 at 50% strain.

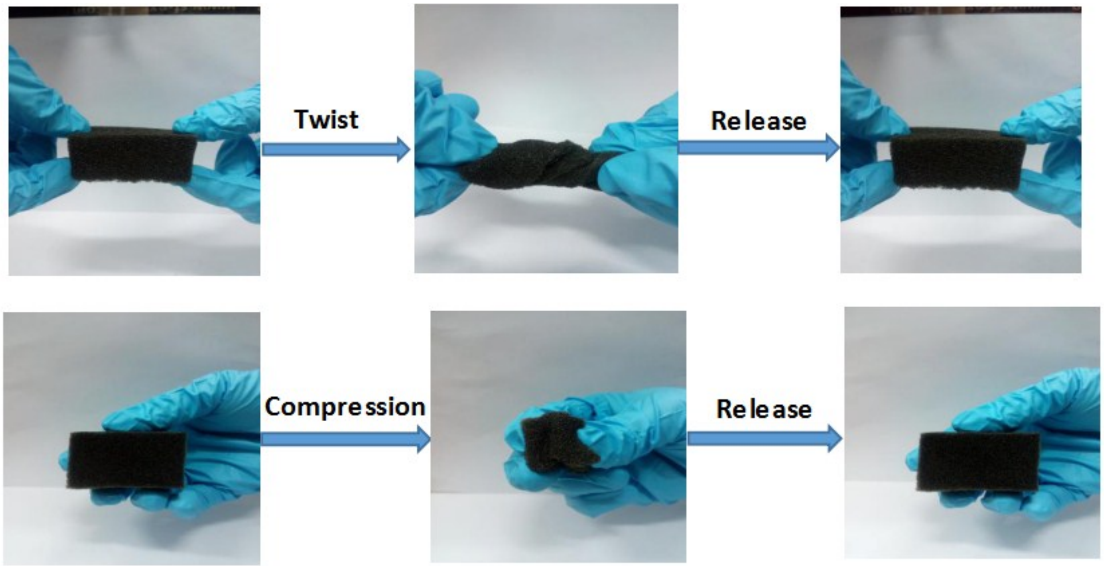

Figure S6 The twist and compression pictures of the prepared PU/RGO foams

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