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

Supporting Information

High Performance Broadband Acoustic Absorption and Sound Sensing of Bubbled Graphene Monolith

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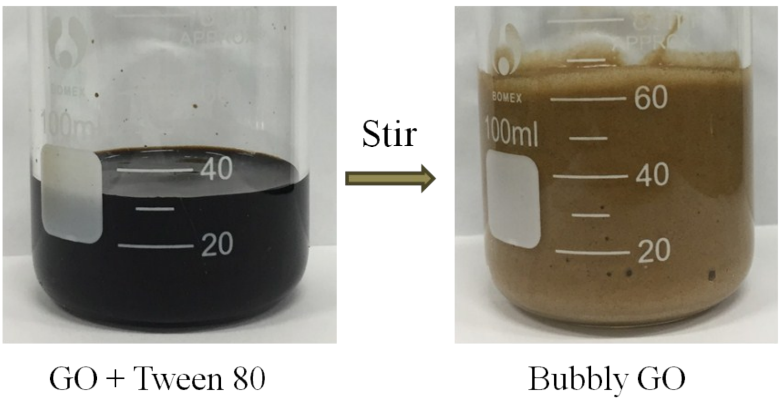

Figure S1. Photographs of the 7 mg mL^{-1} GO dispersion with Tween 80 (left) and as-made bubbly GO dispersion with about two times volume expansion (right).

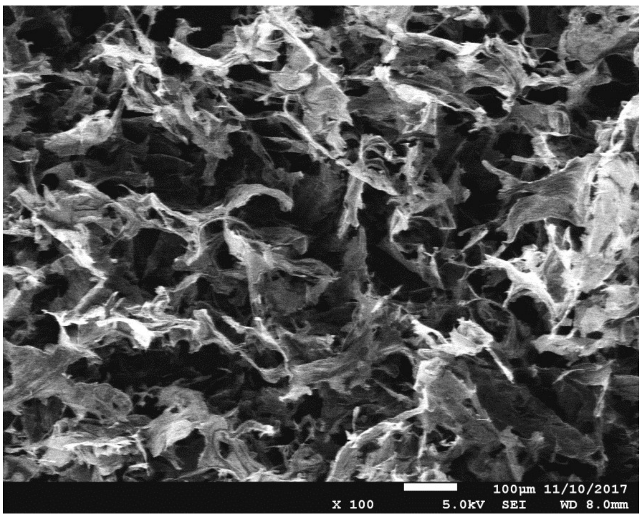

Figure S2. SEM image of normal graphene foam without bubble template.

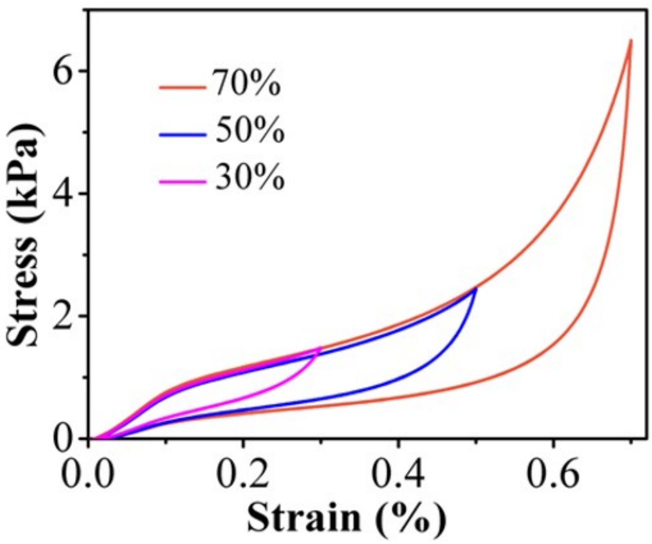

Figure S3. The stress-strain curves of BGM at small compressive strains.

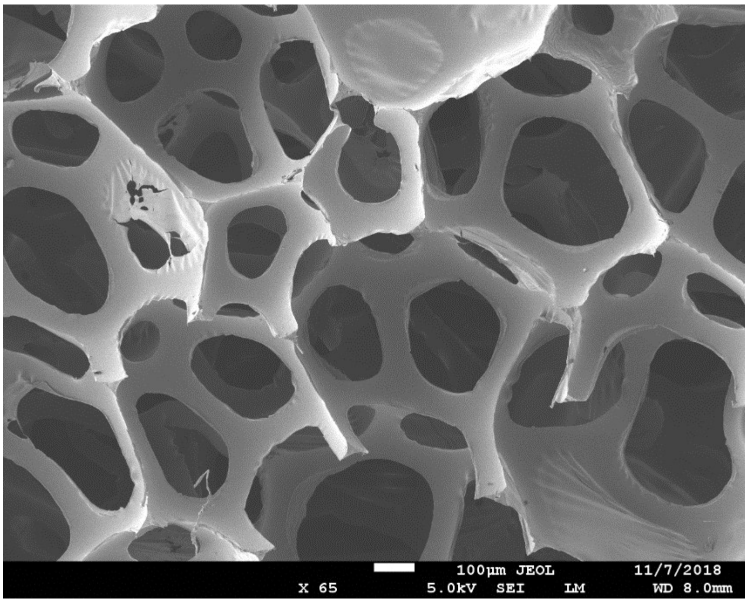

Figure S4. SEM image of commercial PU foam.

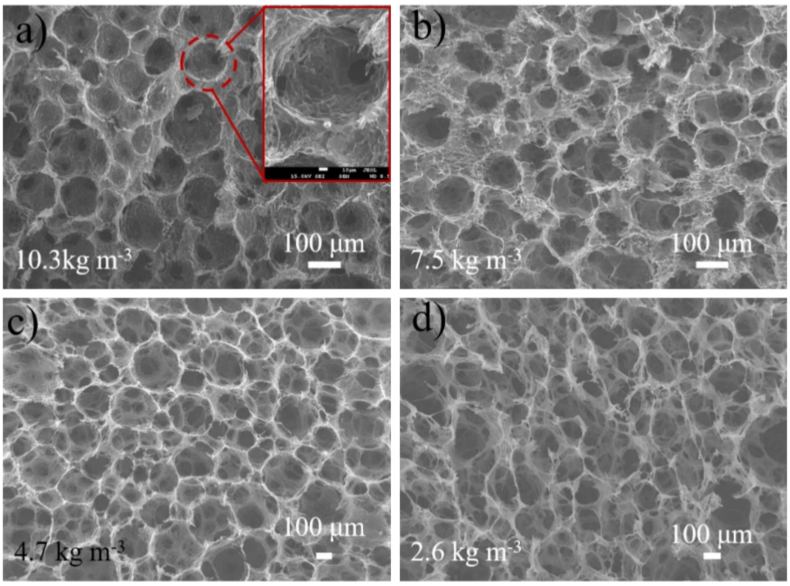

Figure S5. a-d) SEM images of BGMs with different performance density range from 2.6 to10.3 kg m^{-3}.

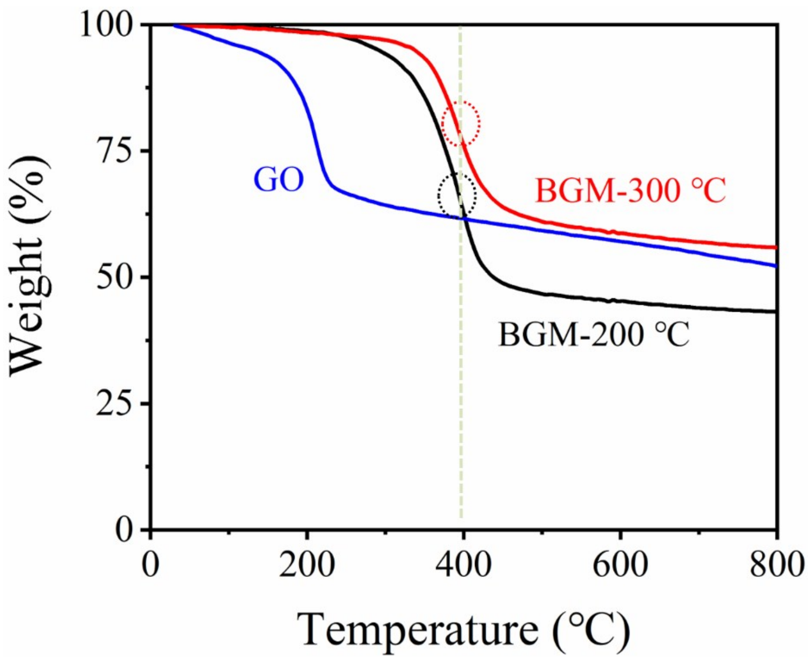

Figure S6. TGA curve of GO and BGMs annealed under different temperature (N_2 atmosphere). Pyrolysis of Tween 80 occurred at about 400 ℃.

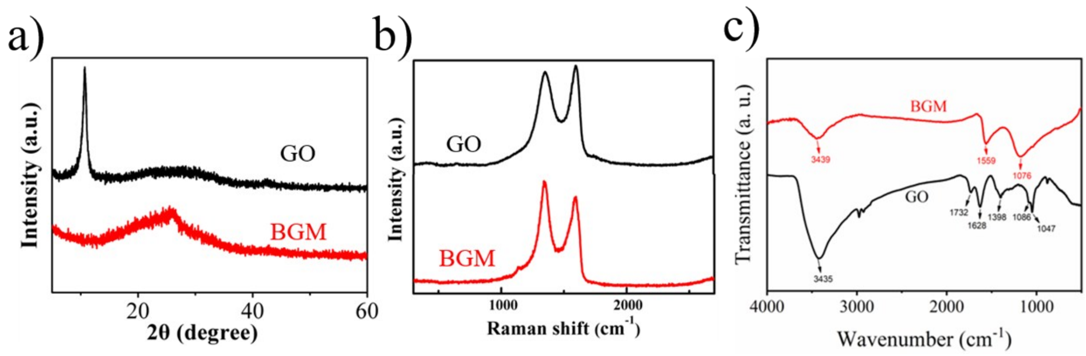

Figure S7. a) XRD patterns, b) Raman spectra and c) FTIR spectra of GO and BGM annealed in 300 ℃.

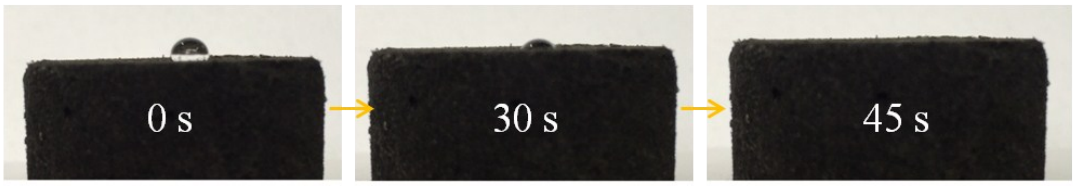

Figure S8. Photographs of the wettability for BGM annealed under 200℃: water drop could be absorbed completely within 45 s.

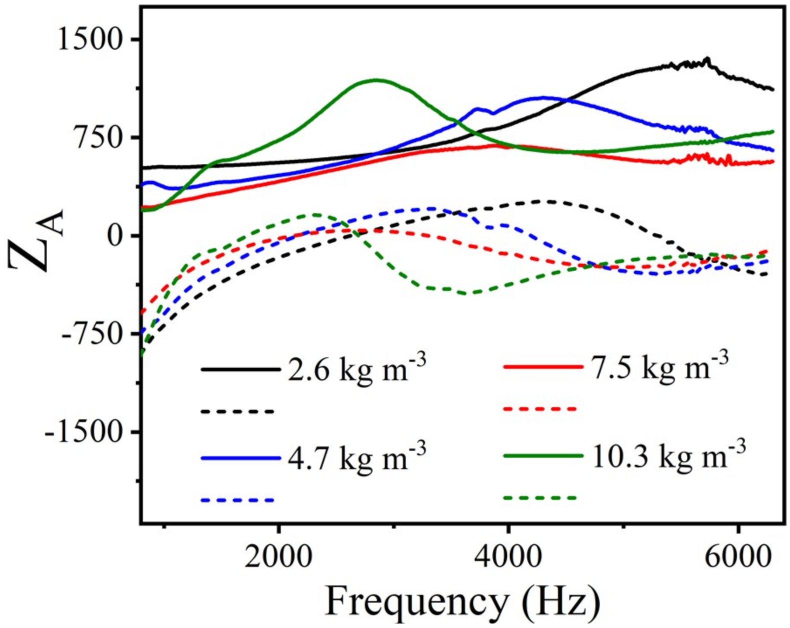

Figure S9. Impedance for BGMs with different density.

Table S1. Comparison of density, thickness, porosity, acoustic activity and flow resistivity for BGM with commercial acoustic absorption material or absorption materials reported previously.

Name	*Density (kg m^{-3})*	*Thickness (mm)*	*Porosity (%)*	α_n	*Flow resistivity (Pa s m^{-2})*	*Re.*
This work	**7.5**	**50**	**99.7**	**0.901**	55200	
PU foam	20	50	96.0	0.810	30000	
Normal G foam	7.5	50	99.7	0.823	41245	
Wood fibers in PU foam	72	20	65.1	0.756	18000	1
Needled nonwovens	110	11	89.4	0.601	83584	2
PU/CNT foam	27	30	95.0	0.862	5717±740	3
Melamine/GO foam	247	26	-	0.824	40932	4
Cigarette filters	93	50	95.9	0.893	21314	5
Glass fibers	115	30	95.4	0.832	10468	6
Al foam	400	24	88-90	0.744	-	7
Metal fiber	-	48	90.9	0.896	18980	8
Rice hull in PU foam		40		0.695	-	9

Table S2. Normalized absorption coefficients of BGMs with different densities and thicknesses.

Name	α_n	Flow resistivity (Pa s m^{-2})
7.5 kg m^{-3}-10 mm (800-6300 Hz)	0.793	55200
7.5 kg m^{-3}-20 mm (800-6300 Hz)	0.867	55200
7.5 kg m^{-3}-30 mm (800-6300 Hz)	0.919	55200
7.5 kg m^{-3}-40 mm (800-6300 Hz)	0.934	55200
7.5 kg m^{-3}-50 mm (800-6300 Hz)	0.927	55200
7.5 kg m^{-3}-40 mm (60-6300 Hz)	0.882	55200
7.5 kg m^{-3}-50 mm (60-6300 Hz)	0.901	55200
30 mm-2.6 kg m^{-3} (800-6300 Hz)	0.794	19800
30 mm-4.7 kg m^{-3} (800-6300 Hz)	0.864	33800
30 mm-7.5 kg m^{-3} (800-6300 Hz)	0.919	55200
30 mm-10.3 kg m^{-3} (800-6300 Hz)	0.740	98790

Table S3. Comparison of acoustic absorption coefficients for BGM with other commercial acoustic absorbers used in building structures.[10] [11] [12]

Materials	Thickness (mm)	Acoustic absorption coefficient				
		500 Hz	1000 Hz	2000 Hz	4000 Hz	6000 Hz
Our work	50	0.72	0.90	0.92	0.95	0.95
Melamine foam	26	0.22	0.42	0.62	0.83	-
Polyurethane foam α_0	40	0.2	0.59	0.68	0.85	-
Cocos fiber roll felt	29	0.22	0.35	0.47	0.57	-
Rock wool	50	0.92	0.90	0.88	0.88	-
Wood	16	0.10	0.09	0.08	0.07	-
Aluminum foam	20	0.13	0.22	0.52	-	-
Acoustical plaster	25	0.66	0.65	0.62	0.68	-
Natural coir fiber	30	0.28	0.84	0.73	0.82	-
Extra-fine glass wool	30	0.38	0.89	0.81	0.98	-
Mineral cotton	80	0.65	0.75	0.88	0.92	-
Petate	30	0.63	0.72	0.90	0.97	-

Reference

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