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Air-dried, high-density graphene hybrid aerogels for phase change composites with exceptional thermal conductivity and shape stability

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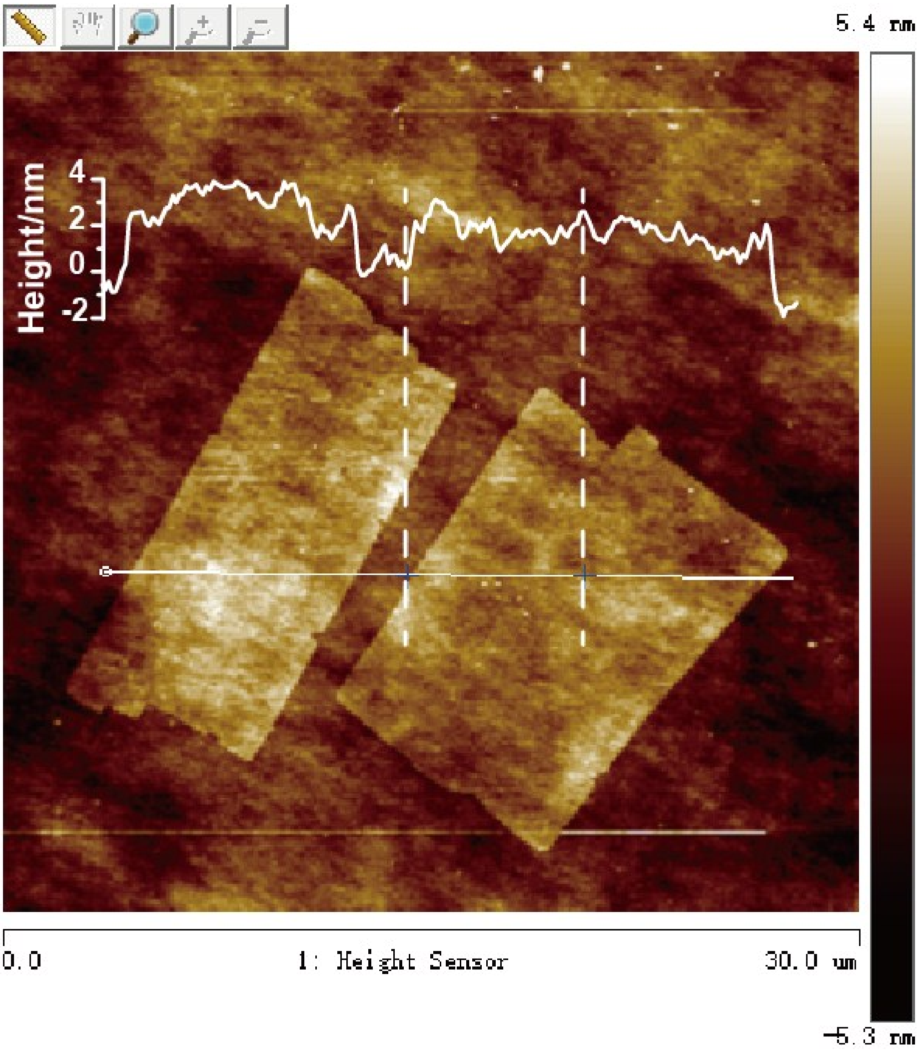

Fig. S1. AFM image of GNPs.

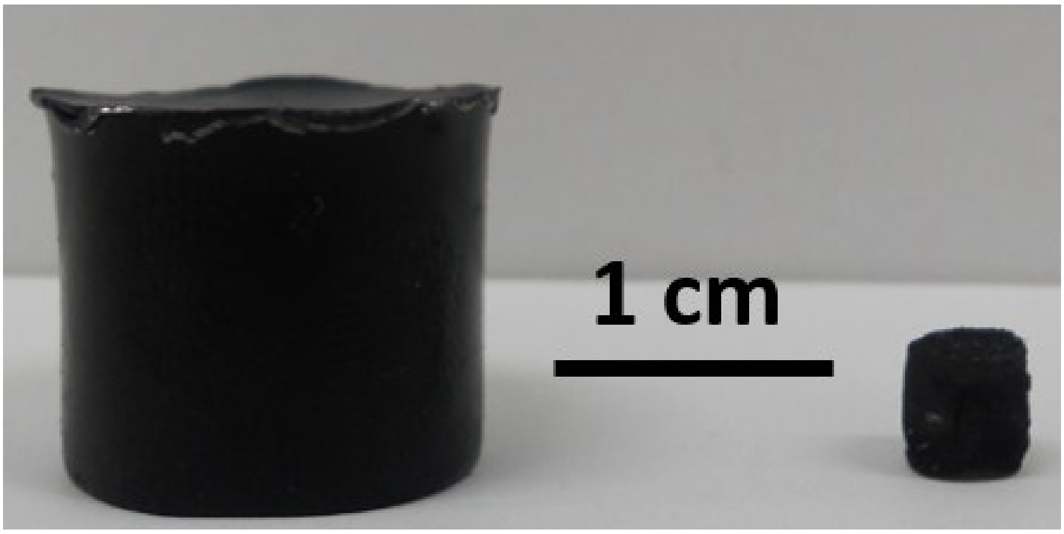

Fig. S2. Digital images of RGO monolith before and after ambient drying.

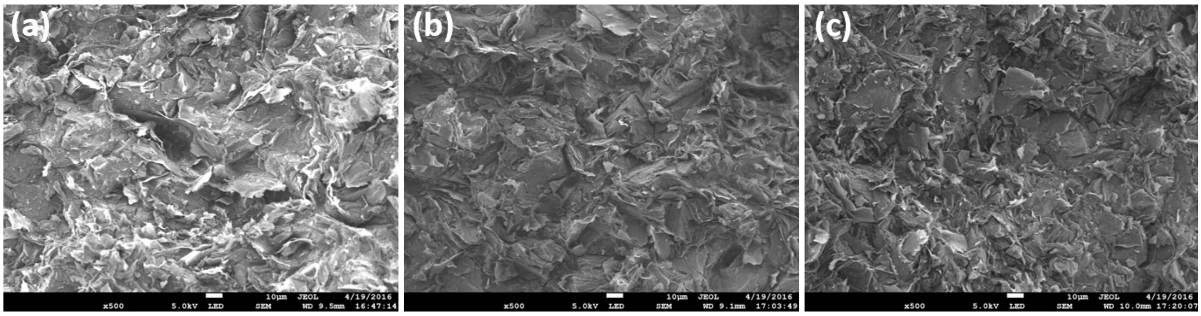

Fig. S3 SEM images of ORG composites of (a) ORG-5, (b) ORG-10, and (c) ORG-15.

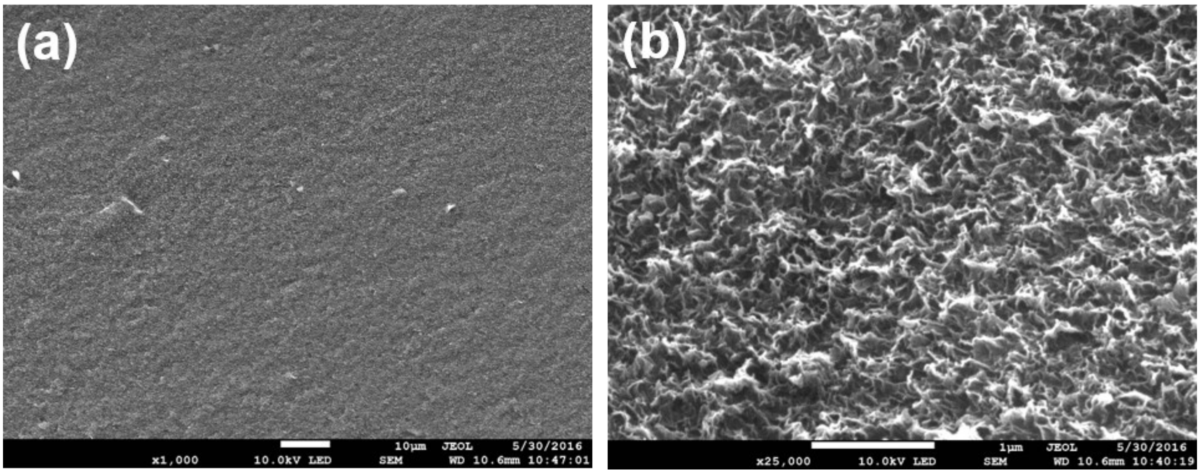

Fig. S4. (a) Low and (b) high magnification SEM images of RGO monolith prepared by ambient drying.

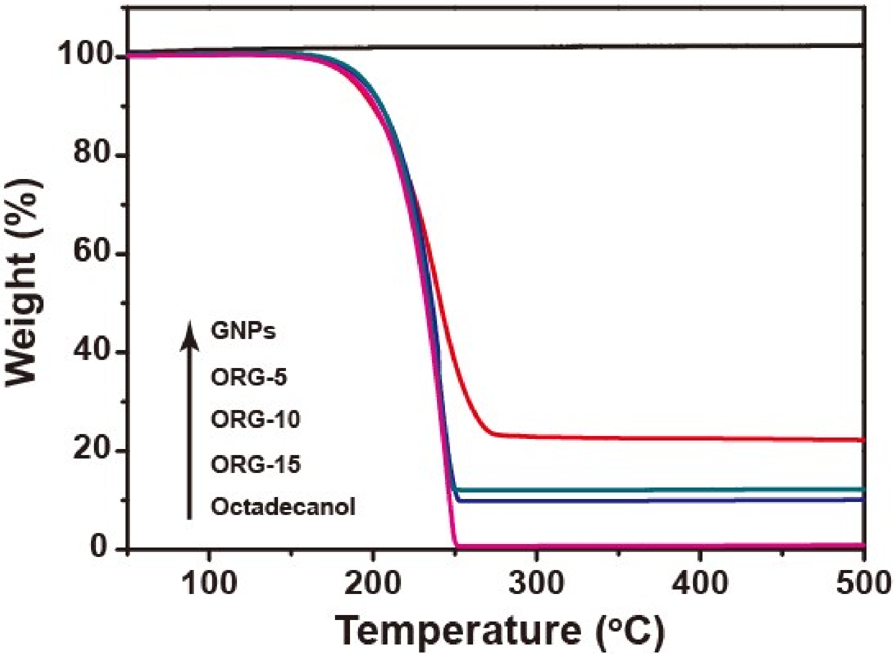

Fig. S5. TGA curves of 1-ctadecanol and ORG composites.

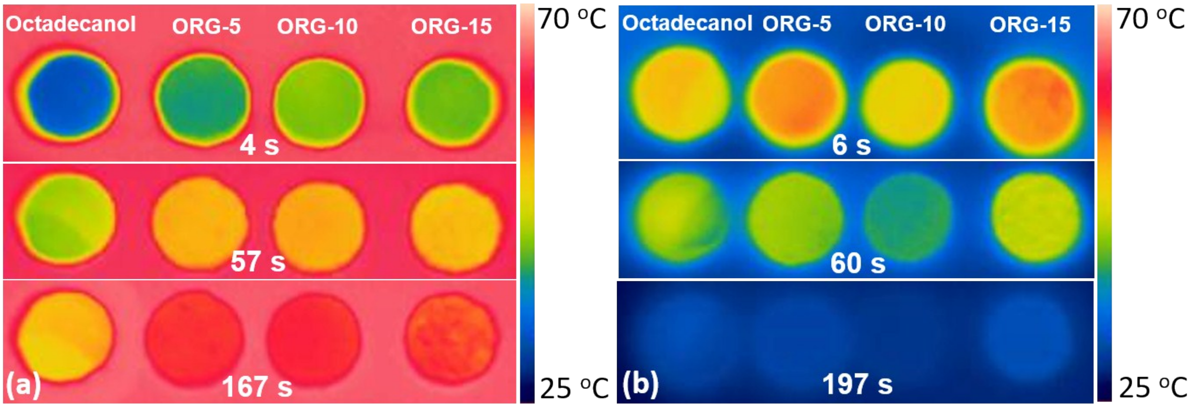

Fig. S6. Infrared camera images of 1-octadecanol and ORG composites: (a) heating process; (b) cooling process. All ORG composites show faster thermal responses than neat 1-octadecanol, and the ORG-10 composite shows the fastest thermal response. For example, after heated for 167 s, ORG-10 composite shows the highest temperature (~59.5 °C) and the 1-octadecanol shows the lowest temperature (~53.2 °C). Then, these ORG composites and 1-octadecanol were immediately transferred to a stainless steel plate to cool down. 1-octadecanol has a low temperature at 6s because of its lowest ending temperature in the heating process. At 197s, the ORG-10 composites show the lowest temperature due to their high thermal conductivities.

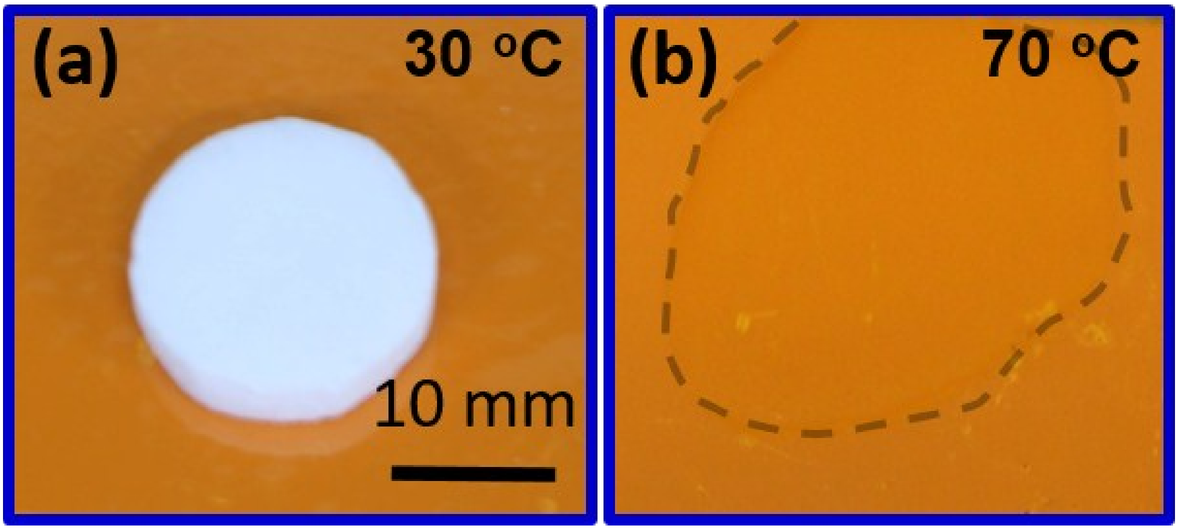

Fig. S7. Digital images of neat 1-octadecanol at (a) 30 °C and (b) 70 °C.

Table S1. Comparisons of thermal conductivities of the phase change composites with their counterparts reported in the literature.

Filler	Matrix	Content (wt%)	Thermal conductivity (W m^{-1} K^{-1})	Ref.
RGO/GNP-10	1-Octadecanol	12	5.92	This work
RGO/GNP-15	1-Octadecanol	10.3	4.61	This work
Annealed graphene at 2200 °C	1-Octadecanol	10	3.55	1
Expanded graphite	Paraffin	10	2.7	2
Graphene		10	0.5	
Graphene	Octadecanoic acid	15	2.635	3
Expanded graphite	Paraffin	10	0.82	4
Graphite	Epoxy	10	0.54	5
Graphene nanoplatelets	Paraffin	10	2.0	6
Graphene nanoplatelets	Polyphenylene sulfide	23.9	4.41	7
Silica coated graphite	Polybutylene terephthalate	22.69 vol%	3.3	8
Graphene nanoplatelets	Epoxy	40	6.55	9
		30	4.42	
		20	2.76	
		10	1.39	
RGO sheets	Nylon 6	10	0.42	10
Graphite foam	Paraffin	4	3.54	11

Table S2. BET surface areas and BJH adsorption pore volumes of the hybrid aerogels.

Samples	BET surface Area (m^2 g^{-1})	BJH adsorption pore volume (cm^3 g^{-1})
RGO/GNP-5	32.8	0.12
RGO/GNP-10	27.8	0.12
RGO/GNP-15	23.7	0.11

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