Supporting Information:

Leak-free and shape-stabilized phase change composites with radial spherical SiO_2 scaffolds for thermal management

Yuxuan Zhang [a], Jialiang Zhou [b], Ziye Chen [a], Zexu Hu [a,*], Mugaanire Tendo Innocent [a], Siyu Yin [a], Hengxue Xiang [a,*], Jin Wen [a] and Meifang Zhu [a]

[a] State Key Laboratory for Modification of Chemical Fibers and Polymer Materials, College of Materials Science and Engineering, Donghua University, Shanghai 201620, China

[b] Jiangsu Gem Advanced Fiber Materials Research Institute Co., Ltd, Nantong 226000, China

Corresponding author:

Tel: +86 21 67792857; Fax: +86 21 67792855.

E-mail address: huzexu@dhu.edu.cn (Z.X. Hu), hengxuexiang@dhu.edu.cn (H.X. Xiang)

Figure S1. Digital photos of radial spherical maple fruit.

(a) fresh fruit, (b) dried fruit after the release of seeds.

Figure S2. Synthetic route of of $RSSiO_2$.

Figure S3. SEM images, TEM images, particle size distribution, and N_2 sorption isotherm (pore size distribution in inset) with a urea concentration of (a) 0.6 g and HMT concentrations of (b) 0.2 g, (c) 0.4 g, (d) 0.8 g, (e) 1.0 g.

Figure S4. SEM images, TEM images, particle size distribution, and N_2 sorption isotherm (pore size distribution in inset) with a HMT concentration of 0.6 g and 1-pentanol concentrations of (a) 1.1 mL, (b) 1.3 mL, (c) 1.7 mL, (d) 1.9 mL.

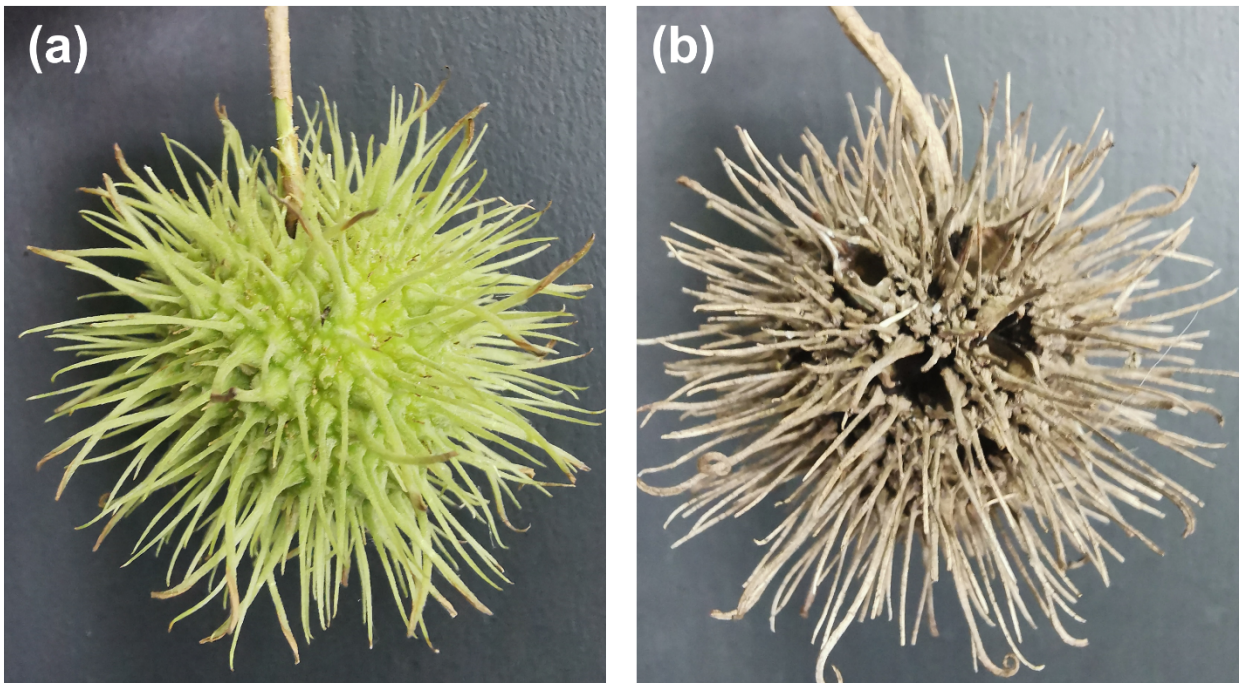
Figure S5. **Thermal management abilities of $RSSiO_2$/PEG composites.** (a) Performance of the heat storage of $RSSiO_2$ and $RSSiO_2/PEG_{70}$: (a1) from -5 ℃ to 40 ℃, (a2) from -5 ℃ to 60 ℃, (a3) from -5 ℃ to 70 ℃. (b) Performance of the heat release on $RSSiO_2$ and $RSSiO_2/PEG_{70}$: (b1) from 80 ℃ to 25 ℃, (b2) from 80 ℃ to 15 ℃, (b3) from 80 ℃ to 5 ℃.

Table S1 Thermal stability parameters of $RSSiO_2$/PEG composites.

Table S2 DSC heating and cooling characteristics of neat PEG and $RSSiO_2$/PEG.

Table S3 Diffraction peak positions and crystallinity of PEG and $RSSiO_2/PEG_x$.

Table S4 DSC parameters of heat-treated $RSSiO_2/PEG_{70}$ under 100 cycles of melting/ crystallization.



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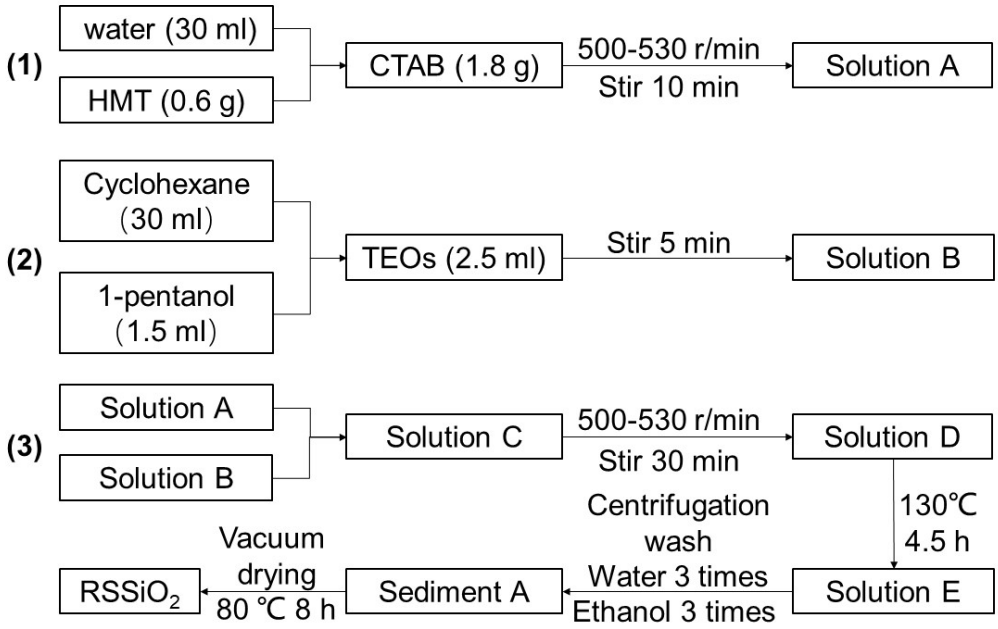

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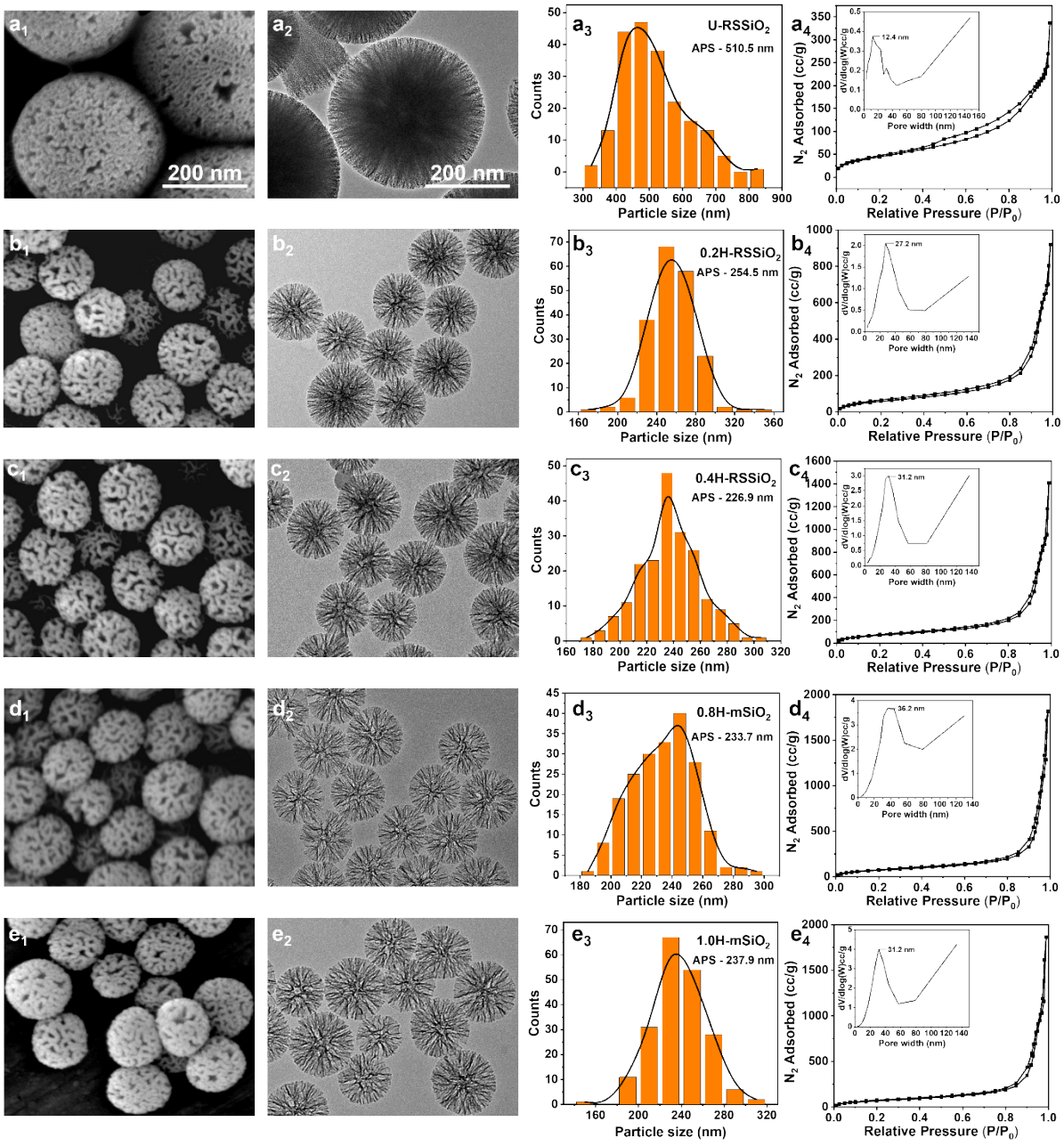

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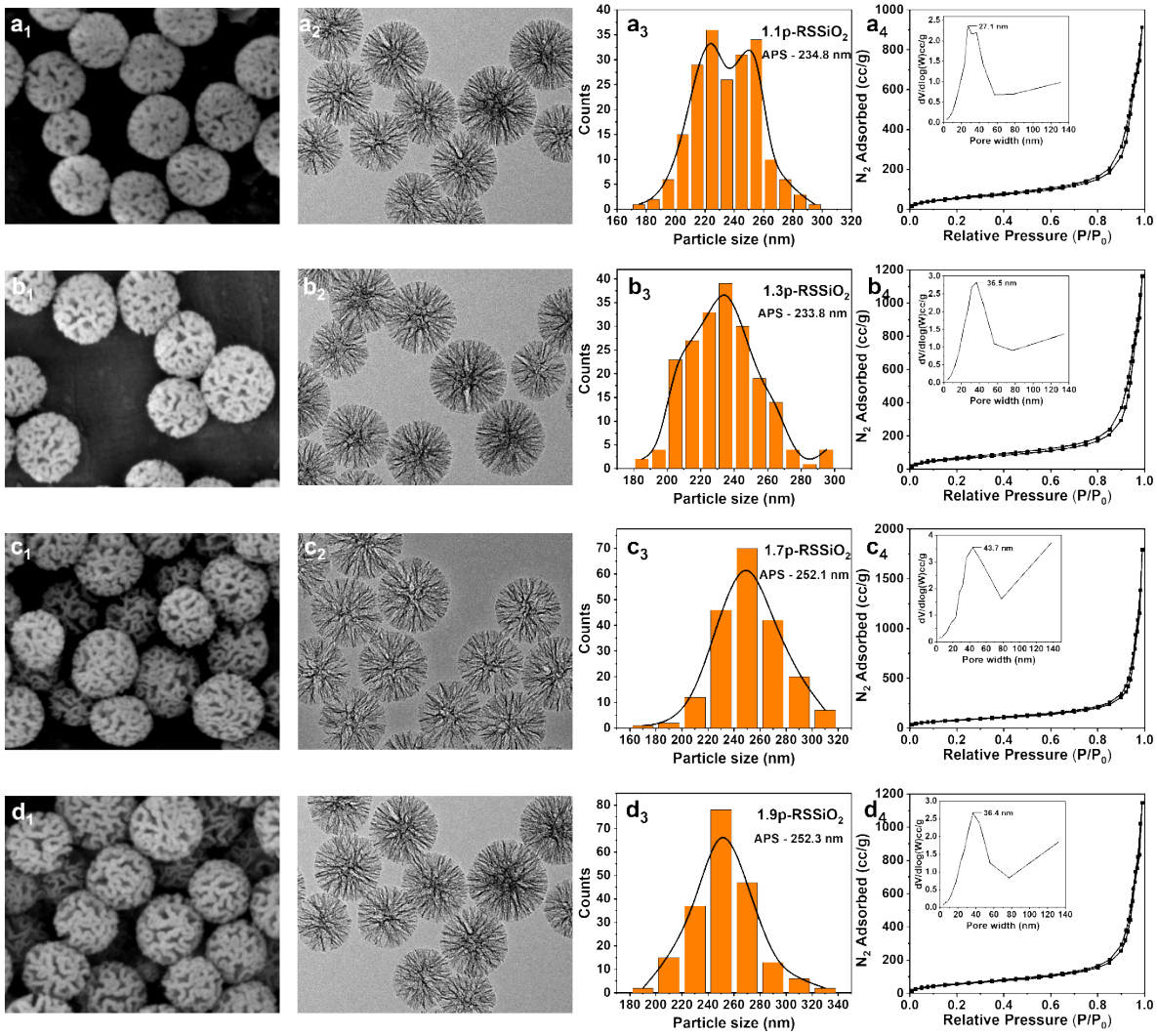

Figure S4. SEM images, TEM images, particle size distribution, and N_2 sorption isotherm (pore size distribution in inset) with a HMT concentration of 0.6 g and 1-pentanol concentrations of (a) 1.1 mL, (b) 1.3 mL, (c) 1.7 mL, (d) 1.9 mL.

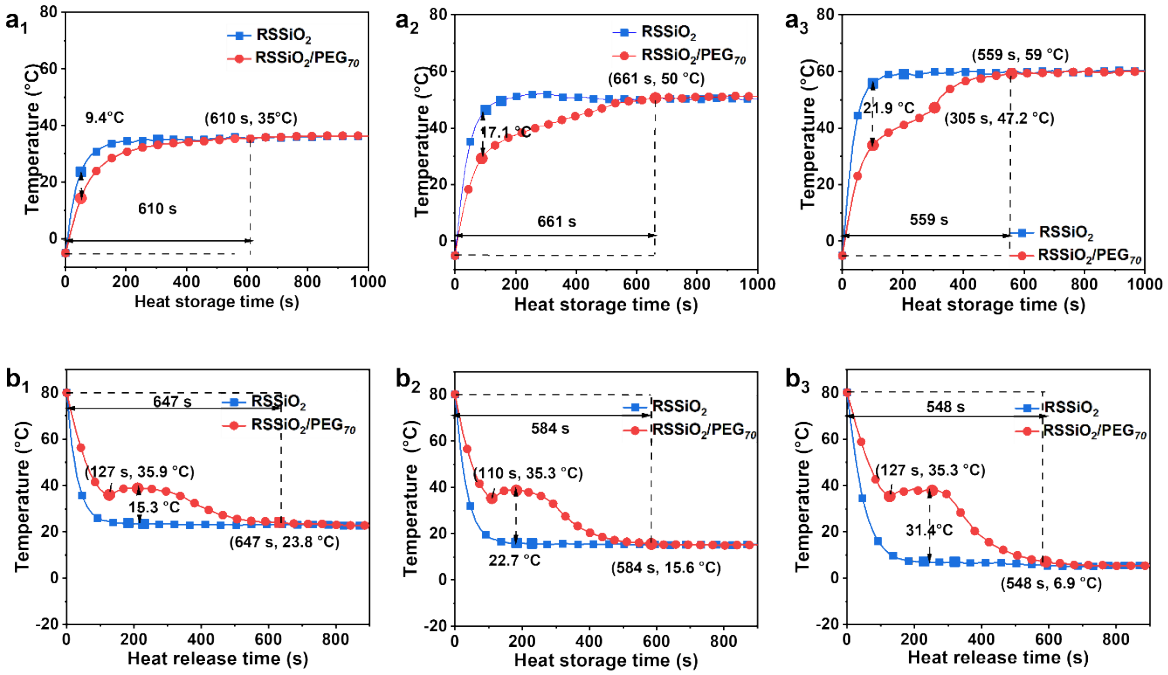

Figure S5. **Thermal management abilities of $RSSiO_2$/PEG composites.** (a) Performance of the heat storage of $RSSiO_2$ and $RSSiO_2$/PEG: (a1) from -5 ℃ to 40 ℃, (a2) from -5 ℃ to 60 ℃, (a3) from -5 ℃ to 70 ℃. (b) Performance of the heat release on $RSSiO_2$ and $RSSiO_2$/PEG: (b1) from 80 ℃ to 25 ℃, (b2) from 80 ℃ to 15 ℃, (b3) from 80 ℃ to 5 ℃.

Table S1 Thermal stability parameters of $RSSiO_2$/PEG composites.

Samples	PEG(wt%)	Decomposition temperature(℃)
$RSSiO_2$/PEG	100%	301.3
	40%	347.7
	50%	357.7
	60%	363.7
	70%	357.1
	80%	356.8
$RSSiO_2$	0	204.4

Table S2 DSC heating and cooling characteristics of neat PEG and $RSSiO_2$/PEG.

Samples	Tc (℃)	ΔHc (J/g)	Tm (℃)	ΔHm (J/g)
PEG	37.2	151.70	44.3	157.1
$RSSiO_2/PEG_{40}$	18.9	35.7	35.6	42.4
$RSSiO_2/PEG_{50}$	19.1	51.2	38.2	55.4
$RSSiO_2/PEG_{60}$	20.6	63.9	38.8	67.7
$RSSiO_2/PEG_{70}$	31.6	92.9	41.0	96.2
$RSSiO_2/PEG_{75}$	29.6	87.6	40.3	93.0
$RSSiO_2/PEG_{80}$	30.8	92.7	40.5	98.8

Table S3 Diffraction peak positions and crystallinity of PEG and $RSSiO_2/PEG_x$.

Samples	2θ/°	Crystallinity
PEG	5.92, 19.32, 23.04, 24.42	44.10%
$RSSiO_2/PEG_{40}$	14.95, 19.084, 23.154, 26.491,35.86	14.50%
$RSSiO_2/PEG_{50}$	14.814, 19.075, 23.181, 26.76, 35.769	21.00%
$RSSiO_2/PEG_{60}$	14.772, 19.062, 23.194, 26.741, 35.903	30.30%
$RSSiO_2/PEG_{70}$	14.822, 19.005, 23.125, 26.674, 35.764	39.10%
$RSSiO_2/PEG_{75}$	14.608, 18.968, 22.979, 26.704, 35.678	20.60%
$RSSiO_2/PEG_{80}$	14.769, 18.992, 23.131, 26.658, 35.749	31.90%

Table S4 DSC parameters of heat-treated $RSSiO_2/PEG_{70}$ under 100 cycles of melting/ crystallization.

Cycles	T_m(°C)	ΔH_m（J/g）	T_c (°C)	ΔH_c（J/g）
1st cycle	41.0	92.9	31.6	96.2
10th cycles	40.8	92.4	31.2	96.65
20th cycles	41.2	93.1	31.4	97.1
30th cycles	40.9	93	30.9	96.23
40th cycles	40.5	92.7	31.3	97.69
50th cycles	41.1	92.5	31.1	96.4
60th cycles	40.9	93.7	31.0	96.9
70th cycles	40.7	93.5	30.9	96.3
80th cycles	40.8	93.2	31.1	96.2
90th cycles	41.1	93.4	31.0	95.9
100th cycles	40.9	93.1	31.1	96.1