Supporting Information

Stable and Visualized Fatty Acid-based Phase Transition Materials Constructed by Solid-phase Molecular Self-assembly for Thermal Management

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Materials and Methods

Materials. Sodium dodecyl benzene sulfonate (SDBS, >98%) and polydiallyldimethylammonium chloride (PDDA, Mw 70,000, 20_{wt}% in water) were purchased from the Sigma-Aldrich Corporation. Palmitic acid (PA, >98%) and other fatty acids were obtained from Aladdin Reagent Ltd. All reagents were AR grade. Deionized water (18.2 MΩ·cm) was obtained from the ELGA PURELAB classic system.

Preparation of P-S/PA. Stable and visualized fatty acid-based phase transition materials P-S/PA were constructed by solid-phase molecular self-assembly. PDDA (0.1mol/L, 10mL) and SDBS (0.1mol/L, 10mL) solutions are heated to 70℃, separately; PA (0.5g, 2mmol) was gradually added to SDBS solution with constant stirring to be emulsified. After continuous mixing for 0.5h, the PDDA solution was poured into the SDBS/PA solution, and the precipitates formed immediately, through electrostatic interaction. The precipitates were collected after centrifuging for 5 min at 8000 rpm. P-S/PA was prepared, by pressing the precipitates, and it can be processed into any shape, by hot-pressing. Here, the PDDA-SDBS/PA was denoted as P-S/PAx, where x represents the molar ratio of PA to SDBS.

Characterization and Measurements. Scanning electron microscopy (SEM, Hitachi S-4800) was employed to observe the morphology of the P-S/PA at an acceleration voltage of 1kV. Two-dimensional (2D) wide-angle X-ray scattering (WAXS) of P-S/PA were obtained by using a Ganesha system (SAXSLAB, US) equipped with a multilayer focused Cu Kalpha radiation as the X-ray source (Genix 3D Cu ULD) and a semiconductor with LaB_6 for the wide-angle region and silver behenate for the small-angle region. X-ray diffraction (XRD) measurements were taken using a Rigaku Dmax-2400 diffractometer with Cu Ka radiation. The content of PA was obtained by TG analysis, the experiments were carried out under nitrogen flow on a TA Instrument Q600 SDT at a heating rate of 10°C/min. The phase transition of P-S/PA was measured by the differential scanning calorimeter (DSC, Q2000) at a heating/cooling rate of 10°C/min. The thermal energy storage/release behavior of P-S/PA was characterized by an infrared thermal imaging camera (FLIR T620). Visualization of the P-S/PA phase transition was characterized by UV-vis transmission spectrum (Shimadzu UV-1800 ultraviolet-visible spectrophotometer using the transmission mode).

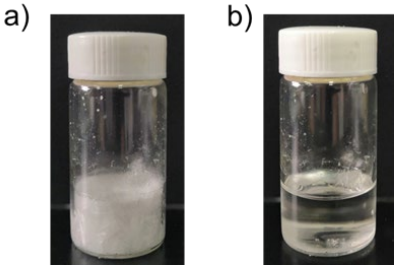

Figure S1 Photographs of PA a) crystallization; b) melting

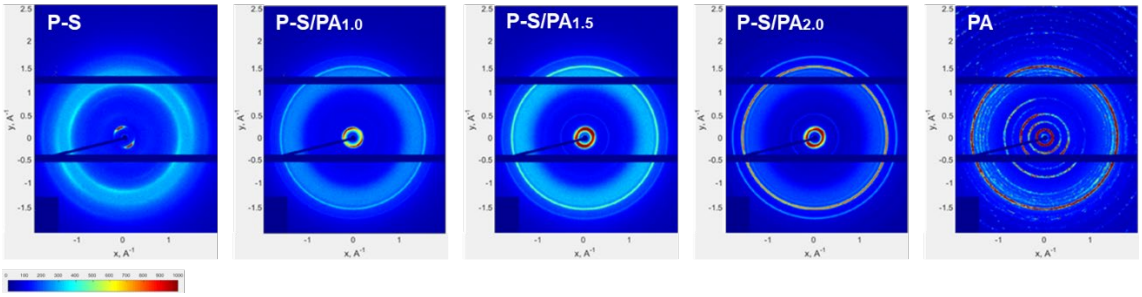

Figure S2 2D-WAXS pattern of P-S/PA with different PA content

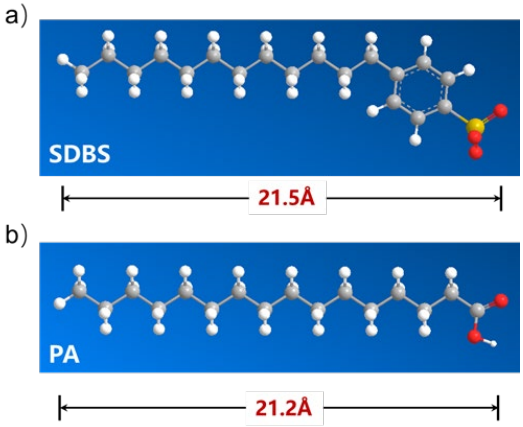

Figure S3 The extending length of a) SDBS; b) PA

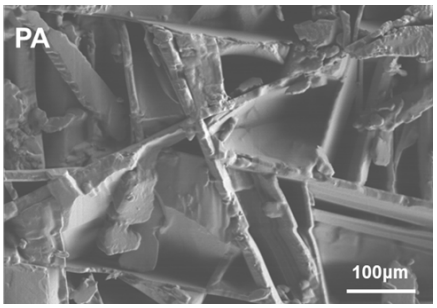

Figure S4 SEM image of PA

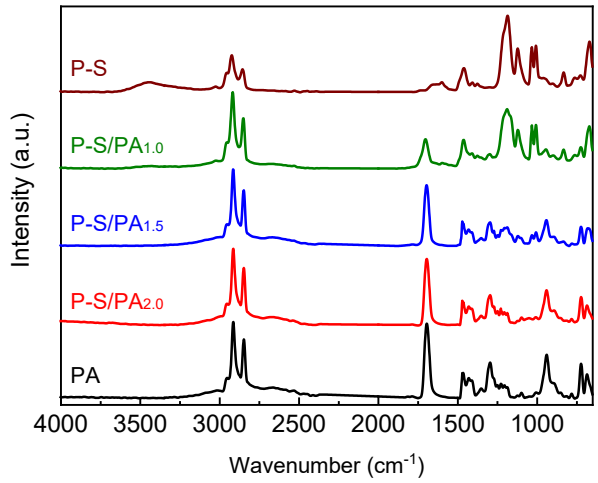

Figure S5 FT-IR spectra of P-S/PA with different PA content

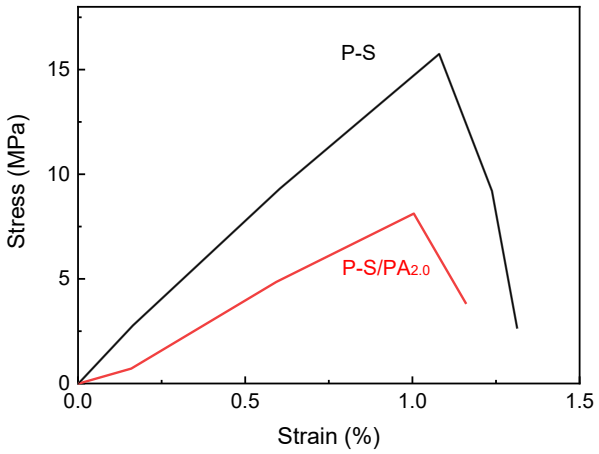

Figure S6 Stress-strain curves of P-S and P-S/PA

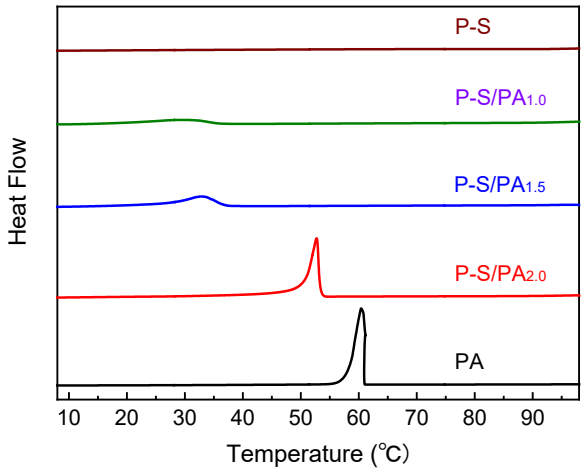

Figure S7 DSC cooling curves of P-S/PA with different PA content

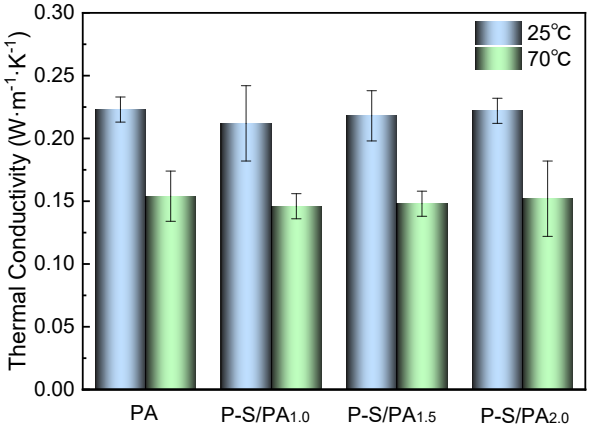

Figure S8 Thermal conductivity of pure PA and P-S/PA with different PA content

Table S1 Thermal performances of P-S/fatty acids with different carbon chain length

P-S/	**Melting process**				**Crystallization process**			
	T_M ℃		ΔH_M J/g		T_C ℃		ΔH_C J/g	
	0	1000	0	1000	0	1000	0	1000
LA	40.7	40.5	94.6	94.2	32.6	32.4	90.5	89.8
MA	52.6	52.4	101.3	100.5	46.1	46.0	96.4	95.8
PA	60.5	60.2	107.3	106.8	52.7	52.4	108.8	99.6
SA	67.5	67.4	103.2	102.8	60.8	60.5	101.2	100.7

Table S2 Thermal performances of P-S/PA after remolding

P-S/PA	**Melting process**		**Crystallization process**	
	T_M ℃	ΔH_M J/g	T_C ℃	ΔH_C J/g
Original	60.5	107.3	52.7	100.2
Remolded	60.4	106.8	52.2	99.8