Supplementary Materials

Stable, Low-Cost Phase Change Material for Building Applications: The eutectic mixture of decanoic acid and tetradecanoic acid

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A. DSC results

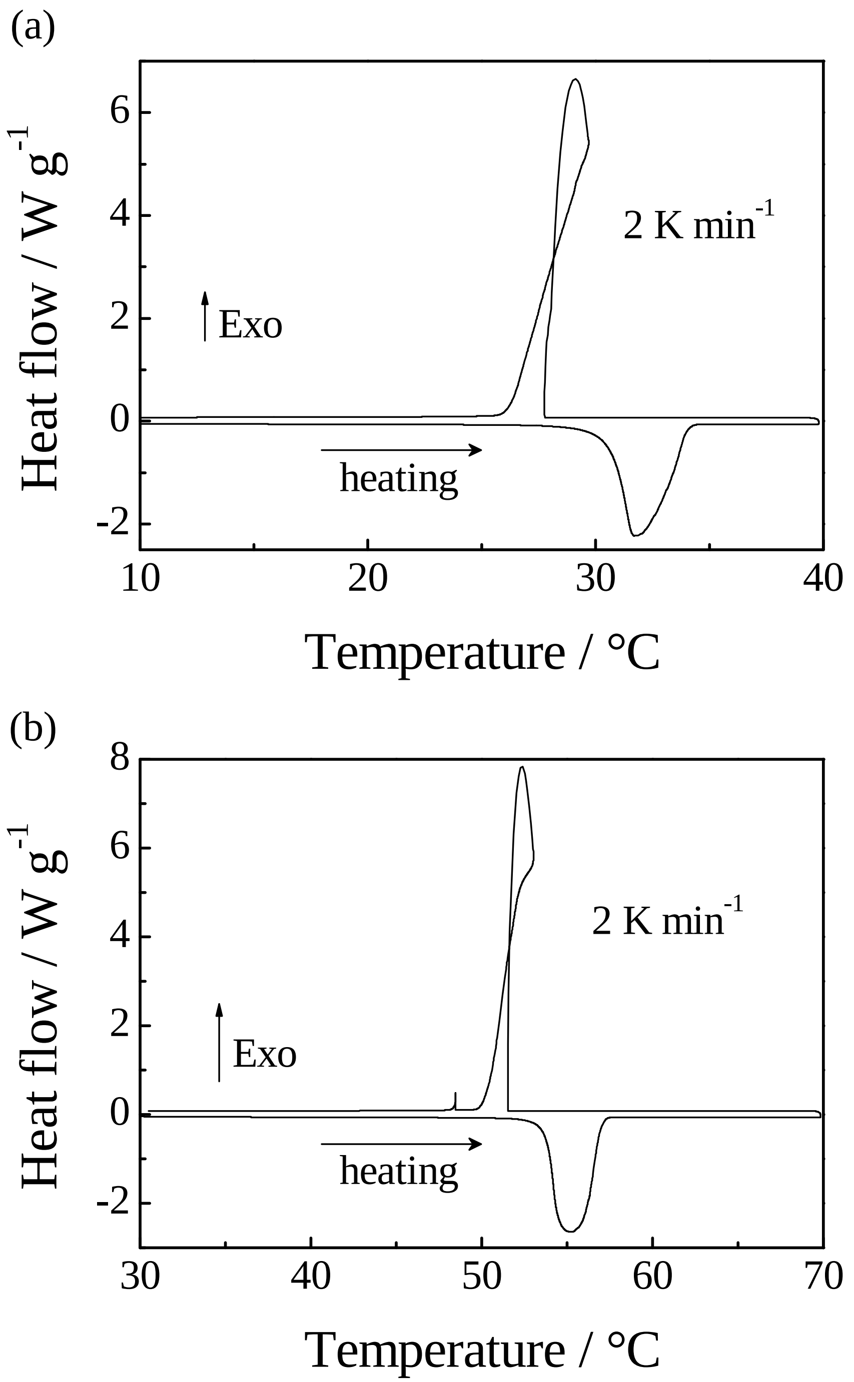

Fig. S1. DSC thermograms of (a) pure decanoic acid, C10 and (b) pure tetradecanoic acid, C14. Loops on cooling are typical for the exothermicity on freezing a super-cooled sample.

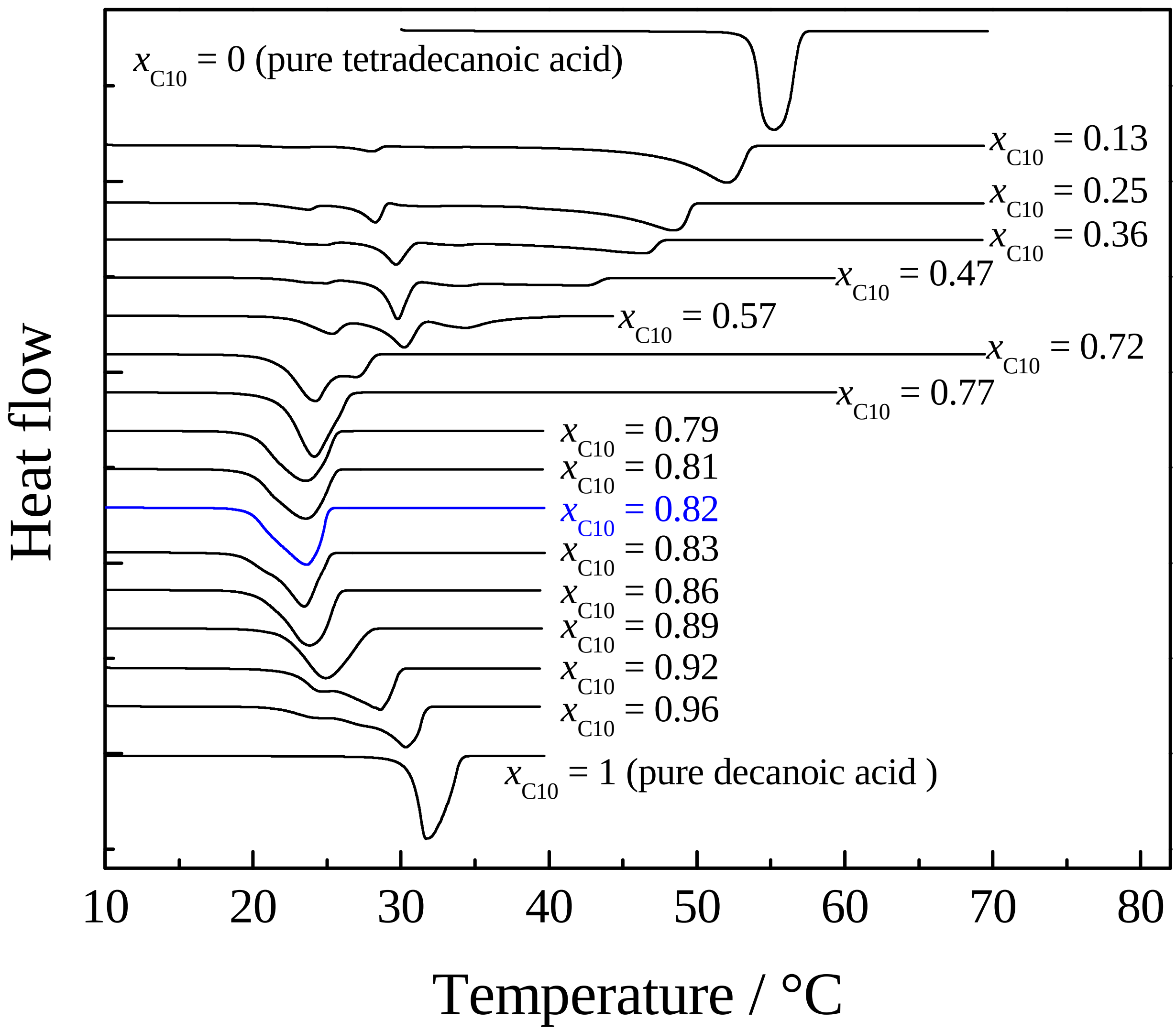

Fig. S2. DSC thermograms of decanoic acid (C10) and tetradecanoic acid (C14) mixtures with various compositions, as determined on heating. The thermogram of the eutectic mixture is shown in blue. All measurements were carried out at a heating rate of 2 K min^{-1}.

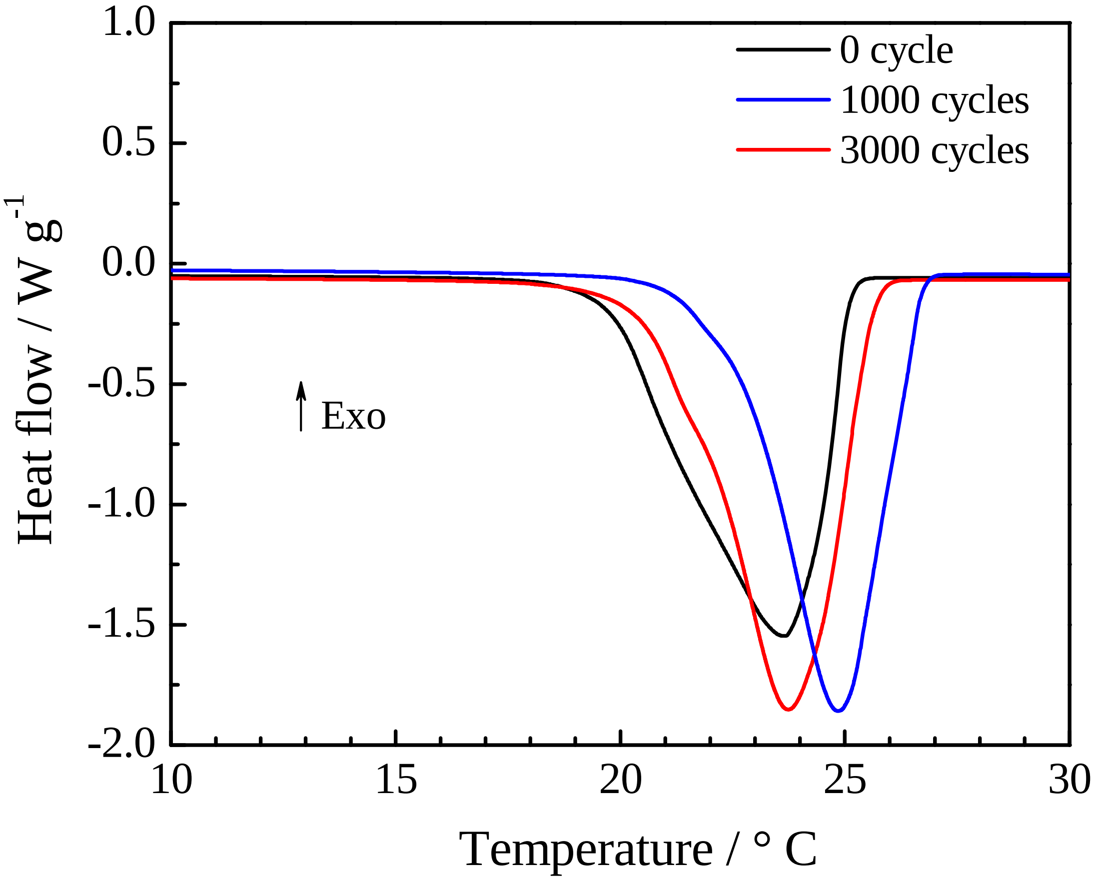

Fig. S3. DSC thermograms of uncycled (0 cycle) eutectic mixture of decanoic acid and tetradecanoic acid (x_{C10} = 0.82) and after 1,000 and 3,000 heat-cool cycles between 10 and 50 °C. All measurements were done on heating at a rate of 2 K min^{-1}. In the full range of cycled samples, there were no general significant trends in terms of shifting of the transition.

Table S1. Latent heat of fusion and T_{onset} of cycled eutectic mixture, as determined by DSC.

Cycle number	**$\Delta_{fus}H$ (J g^{-1})**	**T_{onset} (°C)**
0	153±15	21.1±1.5
100	151±15	22.0±1.5
300	153±15	22.4±1.5
500	152±15	21.8±1.5
1,000	156±16	22.5±1.5
2,000	138±14	20.6±1.5
3,000	145±15	21.2±1.5

B: PPMS fluid cell

A custom-built fluid cell was used for the measurement of the thermal conductivity of the liquid eutectic sample, using the thermal transport option of the Physical Property Measurement System (PPMS). (See the main manuscript for a schematic diagram.)

The cell consisted of a PTFE tube (total length ~ 5.5 mm, sample-space length ~ 1.85 mm; inner diameter ~1.6 mm) threaded to two gold-plated copper leads *via* a 2 mm section of 2-56 brass thread. The cell was filled with the liquid mixture through a small opening in one of the leads; care was taken to avoid trapping air bubbles inside. To prevent leakage, the filling port was sealed with epoxy, as was the PTFE-gold plate junction at each end of the cell.

The thermal conductance of this setup follows the simple system of series resistors:

$$K_{sample} = K_{tot} - K_{bkg} \quad (1)$$

where K_{sample} is sample conductance, K_{tot} is the total conductance (*i.e.* cell+sample), and K_{bkg} is the empty cell (background) conductance. The thermal conductance of the empty fluid cell was measured using the steady-state procedures of the PPMS, in the temperature range from 280 and 340 K. When filled, both vertical and horizontal orientations of the cell were tried, with no significant difference due to convection, as confirmed by finite-element modeling of the cell. For convenience, the vertical orientation was chosen.

The thermal conductance data were fit to a polynomial function that was used to calculate K_{bkg} for the sample temperatures for measurements of K_{tot}, and used in accordance with equation (1) to determine the sample conductance. Thermal conductance was converted to thermal conductivity, taking into account the sample dimensions.

Distilled water was used as a known standard liquid (κ = 0.610 W m^{-1} K^{-1} at 300 K [1]) to validate the measurements of the fluid cell (see Table S2), and gave results within 10% of literature value.

Table S2: Experimental thermal conductance data used to calculate the thermal conductivity of water at ~ 300 K.

T / K	K_{bkg} / W K^{-1}	K_{total} / W K^{-1}	K_{water} / W K^{-1}	κ_{water} / W m^{-1} K^{-1}
300.85	0.001440	0.002189	0.000749	0.661
301.19	0.001443	0.002186	0.000743	0.656
301.23	0.001433	0.002180	0.000747	0.660

Table S3: Experimental data used to calculate the thermal conductivity of the decanoic acid – tetradecanoic acid eutectic mixture (x_{C10} = 0.82) in liquid state at two different temperatures, around 301 and 321 K.

T / K	K_{bkg} / W K^{-1}	K_{total} / W K^{-1}	$K_{eutectic}$ / W K^{-1}	$\kappa_{eutectic}$ / W m^{-1} K^{-1}
301.04	0.001434	0.001686	0.000252	0.223
311.02	0.001460	0.001720	0.000260	0.229

[1] E.W. Lemmon, M.O. McLinden and D.G. Friend, "Thermophysical Properties of Fluid Systems" in **NIST Chemistry WebBook, NIST Standard Reference Database Number 69**, Eds. P.J. Linstrom and W.G. Mallard, National Institute of Standards and Technology, Gaithersburg MD, 20899, http://webbook.nist.gov, (retrieved December 11, 2015).