

## Electronic Supplementary Information

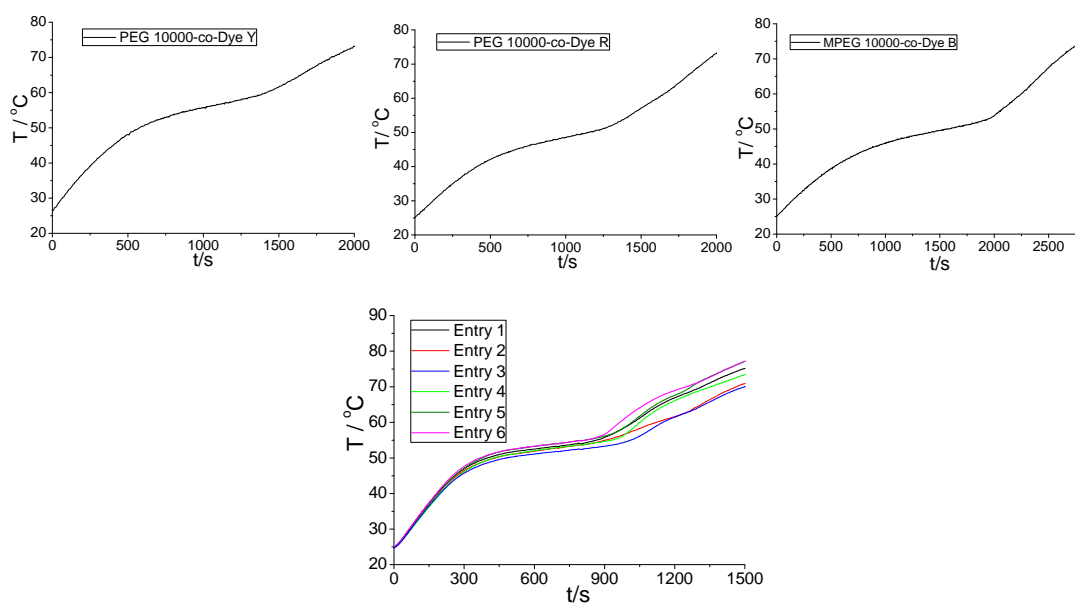
# Light-thermal Conversion Organic Shape-stabilized Phase-change Materials with Broadband Harvesting for Visible Light of Solar Radiation†

Yunming Wang, Bingtao Tang\* and Shufen Zhang

State Key Laboratory of Fine Chemicals, Dalian University of Technology, P.O. Box 89, West Campus, 2#  
Linggong Rd, Dalian 116024, China. E-mail: tangbt@dlut.edu.cn

**Innovation** According to solar irradiation energy density, the OSPCMs with broadband harvest for visible-light (400-700 nm) of solar radiation were designed and synthesized by the color matching of OSPCMs (Yellow, Red and Blue), in which, the utilization efficiency of visible sunlight were further improved. Additionally, these mixed OSPCMs were able to satisfy color requirement. Now a preliminary work has been explored that the OSPCM was drawn wire with good strength and flexibility. Then OSPCMs may be used as smart clothing by fabric blending, wire-drawing, imitation leather. It is of a great worthy that color matching of OSPCMs can be processed directly, and has a wider absorbing visible sunlight range, good mechanical properties.

**Fig. S1 | Schematic was showing the photothermal conversion and energy storage efficiency of OSPCMs under simulated light source irradiation.** The distance between platinum electrode and the sample surface is 1 cm, and the irradiation area is 4.90 cm<sup>2</sup>.



**Fig. S1** The photothermal conversion and energy storage efficiencies of solar thermal conversion (P=1.25 W, 400 nm to 600 nm, ambient temperature=25.1 °C, m=5.0 g).

The photos were shown the states vs temperature of OSPCMs and pure PEG 10000. With the rise of the temperature, the pure PEG from solid to liquid, while the OSPCM's phase transition remains shape stability and no mobility in the complete heating process, even if the temperature is raised to 80 °C or higher.

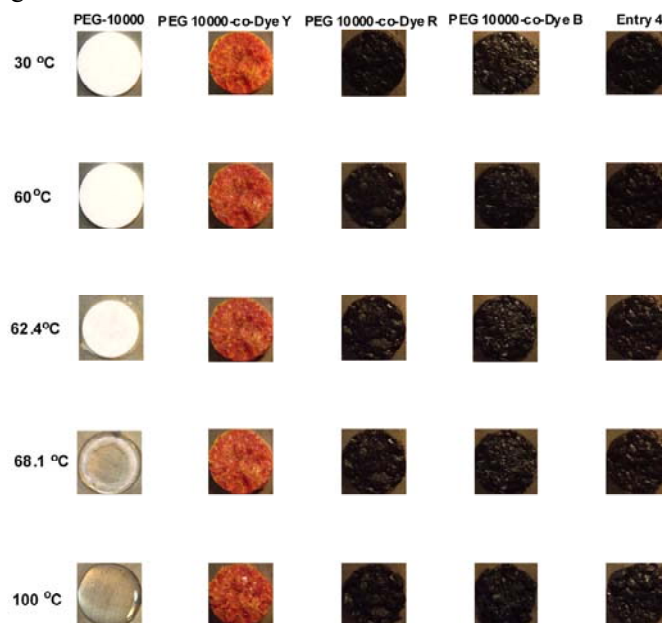


Fig. S2 The temperature rise diagram for OSPCMs and pure PEG 10000.

**Exploratory work** the OSPCM was heated to 120 °C and drawn wire, cooled to room temperature. The wire of OSPCM has a good strength and flexibility (Supporting Information Fig. S3). OSPCMs were made into a film which had good flexibility (Supporting Information Fig. S4).



Fig. S3 The wire-drawing photograph of OSPCMs.



Fig. S4 The film photograph of OSPCMs (Thickness, 2 mm).

**Structural analysis**  $^1\text{H}$  NMR spectra were recorded employing a Varian INOVA 400 NMR

spectrometer at 400 MHz, using solutions of the compounds in 0.5 ml of DMSO- $d_6$  containing TMS (tetramethylsilane) as the internal standard. Mass spectral determinations were made on a Q-TOF mass spectrometry (Micromass, England).

Dye Y:  $^1\text{H}$  NMR (400 MHz, DMSO- $d_6$ , 25 °C, TMS):  $\delta$ =4.84-4.86 (t, 2H, OH), 3.54-3.61 (m, 8H, CH<sub>2</sub>), 6.85-6.87 (d, 2H, Ar-H), 7.41-7.44 (t, 1H, Ar-H), 7.50-7.54 (t, 2H, Ar-H), 7.67-7.78 (d, 2H, Ar-H); IR (KBr pellet): 3453 ( $\delta$  OH), 2939 and 2881 ( $\delta$  CH<sub>2</sub>), 1597 and 1513 ( $\nu$  C=C aromatic), 1249 ( $\nu$  C-N aromatic), 1096 and 1147 ( $\nu$  C-C aliphatic), 1050 ( $\nu$  C-O aliphatic). MS (TOF, Negative) ([M+CH<sub>3</sub>COO]<sup>-</sup>): 348.882; m.p: 136.6-137.7 °C. Elemental analysis: C: 67.81, H: 6.70, N: 14.67.

Dye R:  $^1\text{H}$  NMR (400 MHz, DMSO- $d_6$ , 25 °C, TMS):  $\delta$ =3.60-3.65 (m, 8H, CH<sub>2</sub>), 4.91 (s, 2H, OH), 7.0 (s, 2H, Ar-H), 7.87-7.97 (d, 3H, Ar-H), 8.52 (s, 1H, Ar-H), 8.83 (s, 1H, Ar-H); IR (KBr pellet): 3423 ( $\delta$  OH), 2930 ( $\delta$  CH<sub>2</sub>), 1598 and 1518 ( $\nu$  C=C aromatic), 1577 and 1340 ( $\nu$  NO<sub>2</sub>), 1252 ( $\nu$  C-N aromatic), 1118 and 1145 ( $\nu$  C-C aliphatic), 1050 ( $\nu$  C-O aliphatic); MS (TOF, Negative) ([M+CH<sub>3</sub>COO]<sup>-</sup>): 414.1797; m.p: 160.4-161.5 °C. Elemental analysis: C: 57.12, H: 4.73, N: 19.76.

Dye B:  $^1\text{H}$  NMR (400 MHz, DMSO- $d_6$ , 25 °C, TMS):  $\delta$ =3.65-3.68 (t, 8H, CH<sub>2</sub>), 3.80 (s, 3H, CH<sub>3</sub>), 4.85-4.87 (t, 2H, OH), 7.35 (s, 1H, Ar-H), 8.01 (s, 1H, Ar-H), 8.19-8.21 (d, 1H, Ar-H), 8.48-8.50 (d, 1H, Ar-H), 8.76 (s, 1H, Ar-H), 10.10 (s, 1H, Ar-H); IR (KBr pellet): 3413 ( $\delta$  OH), 2941 ( $\delta$  CH<sub>2</sub>), 1684 ( $\nu$  C=O), 1602 and 1517 ( $\nu$  C=C aromatic), 1566 and 1320 ( $\nu$  NO<sub>2</sub>), 1252 ( $\nu$  C-N aromatic), 1277 and 1163 ( $\nu$  C-O-C aromatic), 1050 ( $\nu$  C-O aliphatic); MS (TOF, Negative) ([M-H]<sup>-</sup>): 441.0114; m.p: 193.4-194.7 °C. Elemental analysis: C: 54.15, H: 5.23, N: 18.91.

PEG 10000-co-Dye Y:  $^1\text{H}$  NMR (400 MHz, DMSO- $d_6$ , 25 °C, TMS):  $\delta$ =2.30 (s, 6H, CH<sub>3</sub>), 3.52-4.29 (m, mH, CH<sub>2</sub>CH<sub>2</sub>O), 4.55-4.78 (t, 8H, OH), 6.81-7.79 (m, 15H, Ar-H), 8.74-8.97 (s, 2H, NH), 9.31-9.63 (s, 2H, NH); ITR (Nujol): 2875 ( $\delta$  CH<sub>2</sub>), 1726 ( $\nu$  C=O), 1599 and 1508 ( $\nu$  C=C aromatic), 1059 and 1145 ( $\nu$  C-N aliphatic), 1359, 1341 and 1278 ( $\nu$  C-N aromatic), 961 and 1097 ( $\nu$  C-O-C aliphatic).

PEG 10000-co-Dye R:  $^1\text{H}$  NMR (400 MHz, DMSO- $d_6$ , 25 °C, TMS):  $\delta$ =2.30 (s, 6H, CH<sub>3</sub>), 3.51-4.32 (m, mH, CH<sub>2</sub>), 4.53-4.89 (m, 8H, CH<sub>2</sub>), 6.47-8.54 (m, 13H, Ar-H), 8.86-9.95 (m, 4H, -NH); ITR (Nujol): 2876 ( $\delta$  CH<sub>2</sub>), 1726 ( $\nu$  C=O), 1519 and 1599 ( $\nu$  C=C aromatic), 1566 and

1359 (v NO<sub>2</sub>), 1279, 1341 and 1359 (v C-N aromatic), 1059 and 1145 (v C-N aliphatic), 961 and 1097 (v C-O-C aliphatic).

PEG 10000-co-Dye B: <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>, 25 °C, TMS): δ=2.23 (s, 3H, CH<sub>3</sub>), 2.30 (s, 6H, CH<sub>3</sub>), 3.51-4.34 (m, mH, CH<sub>2</sub>, CH<sub>3</sub>), 4.54-4.84 (m, 8H, CH<sub>2</sub>), 6.47-8.76 (m, 10H, Ar-H), 8.87-9.62 (m, 5H, -NH), 10.09 (s, 1H, Ar-H); ITR (Nujol): 2856 and 2876 (δ CH<sub>2</sub>), 1727 (v C=O), 1603 and 1518 (v C=C aromatic), 1341 and 1551 (v NO<sub>2</sub>), 1279, 1342 and 1359 (v C-N aromatic), 1059 and 1145 (v C-N aliphatic), 961 and 1097 (v C-O-C aliphatic).