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# Solid-Solid Latent Thermal Energy Storage in Nanotube-Reinforced Pentaerythritol and Pentaglycerine Composites

## - Supplementary Information –

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**Supplementary Note 1: Graphical results**

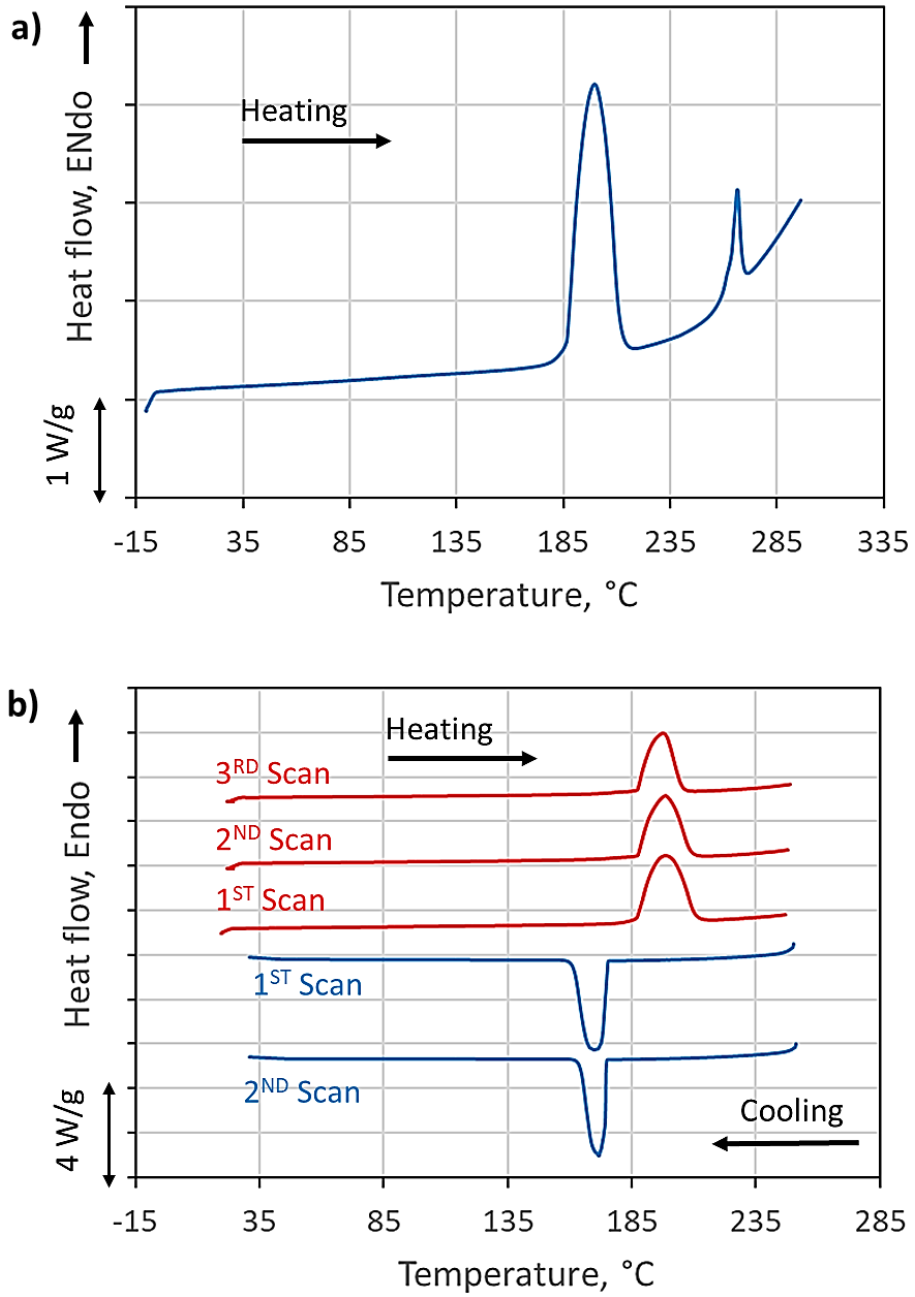



**Figure S1.** (a) Long DSC curve (Solid-Solid and Solid-Liquid phase transition) and (b) multiscans DSC curves (only solid-solid phase transition) of pure PE powder.

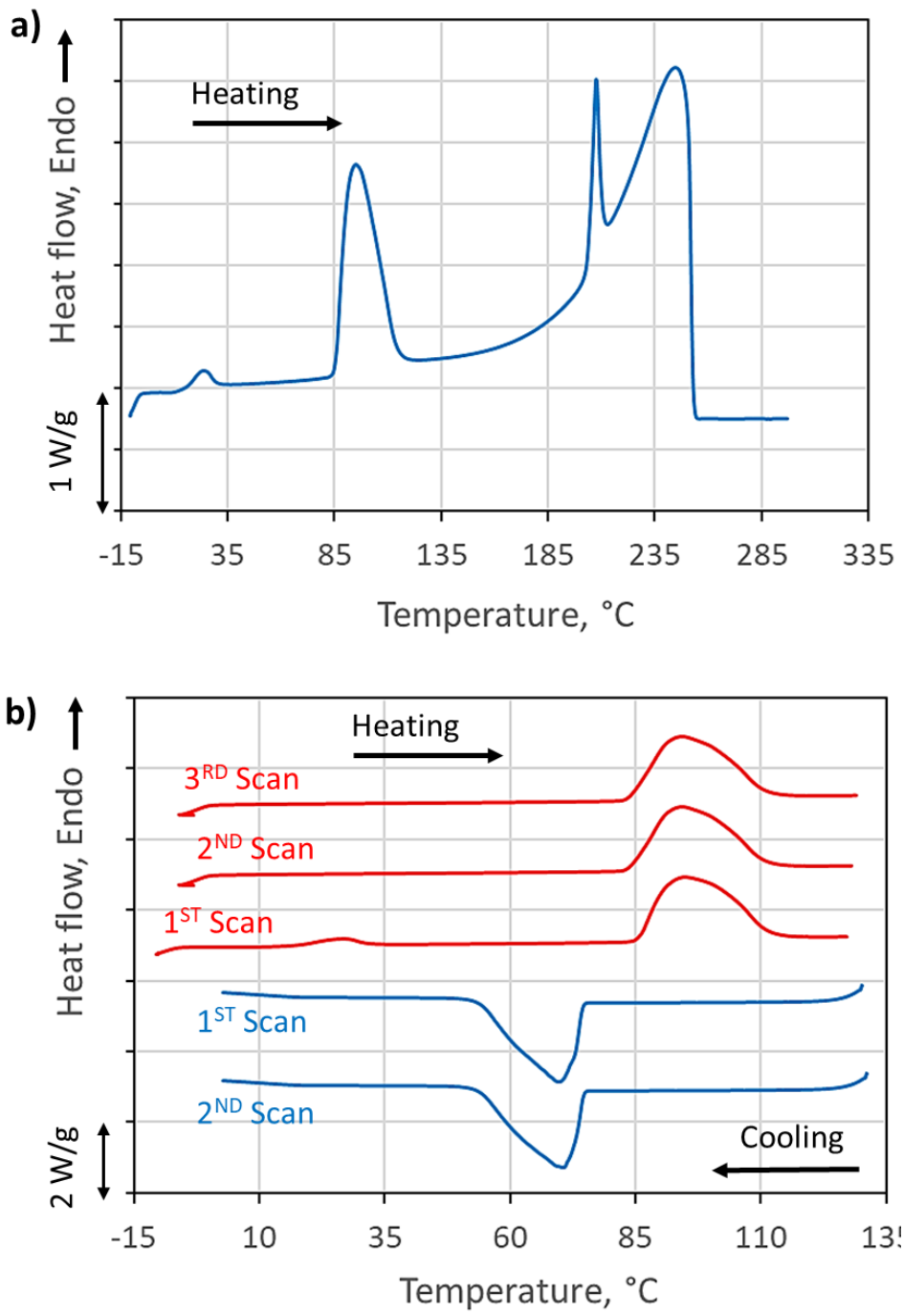
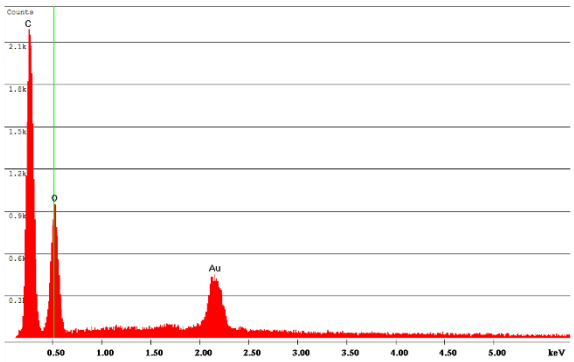


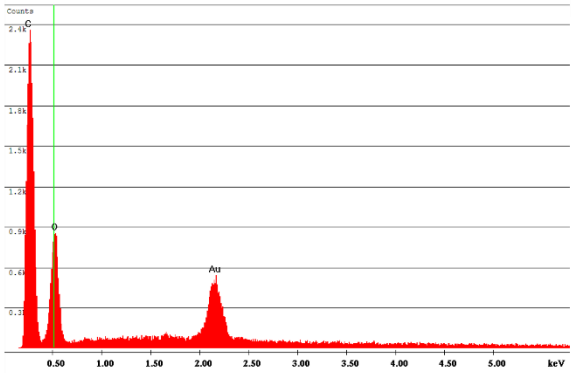

**Figure S2.** (a) Long DSC curve (Solid-Solid and Solid-Liquid phase transition) and (b) multiscans DSC curves (only solid-solid phase transition) of pure PG powder.

**(a)**



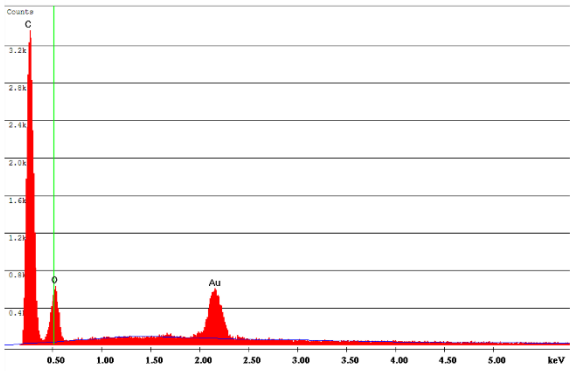

| Element | Weight % | Atomic % |
|---|---|---|
| C | 60.42 | 72.62 |
| O | 29.53 | 26.65 |
| Au | 10.05 | 0.74 |
| Total | 100 | 100 |

**(b)**




| Element | Weight % | Atomic % |
|---|---|---|
| C | 62.16 | 74.94 |
| O | 26.79 | 24.24 |
| Au | 11.05 | 0.81 |
| Total | 100 | 100 |

**(c)**




| Element | Weight % | Atomic % |
|---|---|---|
| C K | 71.34 | 83.70 |
| O K | 17.61 | 15.51 |
| AuM | 11.05 | 0.79 |
| Total | 100 | 100 |

**Figure S3.** EDS elemental mapping of (a) PG, (b) PG/MWCNTs-5% and (c) PG/MWCNTs-10%.

## Supplementary Note 2: Tabulated results

| | PG powder | | PG tablet | |
|---|---|---|---|---|
| | $T_{trans}$(°C) | $\Delta H_{trans}$(J/g) | $T_{trans}$(°C) | $\Delta H_{trans}$(J/g) |
| $Heating_1$ | 97.0±0.8 | 182±6 | 97.9 | 186.3 |
| $Heating_2$ | 96.0±0.6 | 182±5 | 98.0 | 180.3 |
| $Cooling_1$ | 70.1±0.7 | 168±4 | 64.1 | 175.6 |

**Table S1.** Thermal properties of pure PG powder and tablet.

| | PE powder | | PE tablet | |
|---|---|---|---|---|
| | $T_{trans}$(°C) | $\Delta H_{trans}$(J/g) | $T_{trans}$(°C) | $\Delta H_{trans}$(J/g) |
| $Heating_1$ | 199.5±1.0 | 266±5 | 209.0 | 249.42 |
| $Heating_2$ | 200.0±0.5 | 222±5 | 207.2 | 212.18 |
| $Cooling_1$ | 169.3±1.1 | 242±3 | 161.6 | 228.8 |

**Table S2.** Thermal properties of pure PE powder and tablet.

| System | | Heating | | Cooling | |
|---|---|---|---|---|---|
| | | $T_{trans}$(°C) | $\Delta H_{trans}$(J/g) | $T_{trans}$(°C) | $\Delta H_{trans}$(J/g) |
| Closed | 1 | 199.53 | 324.25 | 169.07 | 302.93 |
| | 2 | 198.30 | 308.29 | 167.97 | 289.05 |
| | 3 | 199.56 | 297.17 | - | - |
| Open | 1 | 199.5±1.0 | 266±5 | 169.3±1.1 | 242±3 |
| | 2 | 200.0±0.5 | 222±5 | 170.6±1.2 | 202±6 |
| | 3 | 197.9±0.7 | 187±4 | - | - |

**Table S3.** Comparison of thermal properties of pure PE powder in open and closed system.

| Hydrostatic balance | S. No | Density (g/cm$^3$) | |
|---|---|---|---|
| | | PE | PG |
| | Sample-1 | 1.17 | 1.08 |
| | Sample-2 | 1.18 | 1.07 |
| | Sample-3 | 1.17 | 1.07 |
| | Sample-4 | 1.15 | 1.09 |
| | Sample-5 | 1.14 | 1.07 |
| | **Average** | **1.16** | **1.08** |
| | **Stdev** | **0.01** | **0.008** |

**Table S4.** Density measurement of PE and PG tablet using Archimedes principle.

| Materials | | HEATING | | COOLING | |
|---|---|---|---|---|---|
| | | $T_{trans}$(°C) | $\Delta H_{trans}$(J/g) | $T_{trans}$(°C) | $\Delta H_{trans}$(J/g) |
| PG | 1 | 97.98 | 186.3 | 64.12 | -175.6 |
| | 2 | 98.0 | 180.3 | - | - |
| PG/MWCNTs-1% | 1 | 99.6 | 179.5 | 67.0 | -168.0 |
| | 2 | 98.9 | 174.2 | - | - |
| PG/MWCNTs-5% | 1 | 100.78 | 167.7 | 66.5 | -157.5 |
| | 2 | 99.9 | 164.9 | - | - |
| PG/MWCNTs-10% | 1 | 100.0 | 160.4 | 68.4 | -150.7 |
| | 2 | 99.0 | 144.3 | - | - |

**Table S5.** Latent heat and phase transition temperature of PG/MWCNTs composite PCM tablets.

| MWCNTs (wt. %) | λ (W/mK) Experimental | λ (W/mK) Two step H-J model | λ (W/mK) Modified ME-I model | φ (-) Porosity |
|---|---|---|---|---|
| 0 | 0.3642±0.002 | 0.3642 | 0.3642 | 0.044262 |
| 1 | 0.2694±0.009 | 0.2736 | 0.2705 | 0.215237 |
| 5 | 0.2394±0.006 | 0.2506 | 0.2675 | 0.246588 |
| 10 | 0.2734±0.003 | 0.2281 | 0.2692 | 0.273352 |

**Table S6.** Measured and predicted thermal conductivities, along with porosity values of the PG/MWCNTs composite tablets as a function of the MWCNTs content.