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Supplementary Information

to

Quantifying the Role of Silver Nanoparticle in Modulation of the Thermal Energy Storage Properties of PAM-Ag Nanocomposites

*Tripti Rai, Atul Sharma, Debashis Panda**

Rajiv Gandhi Institute of Petroleum Technology,
(An Institute of National Importance)

Rae Bareli, Uttar Pradesh, India

* To whom correspondence should be addressed. Email: *dpanda@rgipt.ac.in*

Phone: 0535-270-4228. Fax:0535-221-1888.

1. Electron Microscopic Characterizations: The silver nanoparticles formed by reduction of Sodium Borohydride are imaged by a transmission electron microscope (TEM) (HR-TEM FEI Titan G2 60) mounted with field emission gun FEG TEM at 300 kV accelerating voltage. The samples for TEM are prepared on amorphous carbon films supported on a copper grid. The average values are expressed as mean ± standard deviation (SD). The Field Emission Scanning Electron Microscope (FESEM, Zeiss supra 40 VP) is used to image the nanocomposites. FESEM -image analysis are performed by Energy-dispersive spectroscopy (EDS) software INCA. The samples for FESEM are prepared using gold sputtering.

2. Temperature Measurement of Nanocomposites: Nanocomposites are exposed to the solar radiation to find out the effect of the stored energy on them. Difference in stored energy generally gets reflected through temperature variation among samples. Two T type thermocouples (0.2mm O.D. and accuracy ± 0.5ºC) are used to measure the temperature of the samples. These measurements are taken every 10 min using the HP 34972A data acquisition unit. Solar radiation is also recorded during the course of the experiments by using solar radiation sensor of high accuracy, SR-11 pyranometer within ± 20 W/m^2. The experiments are conducted at lattitude, 26.23° N.

3. Mechanical strength measurements: Mechanical properties of the dried nanocomposites are measured by using an H25K-S UTM Tinius Olsen Benchtop Testing Machine. The dried rectangular gels are subjected to stress-strain measurements at ~30°C using a 25 kN load cell and at a crosshead-speed of 10 mm/min. Tensile strength is measured in MPa unit which represents the maximum force (N) per unit cross sectional area (mm^2) required to break the sample.

Elongation at break (E) is defined as the percent ratio of the length of the nanocomposite at the maximum force to the original length. The data represented here is an average of three specimens.

4. Swelling studies: At first the complete dryness of the prepared nanocomposites is achieved by monitoring their weights periodically. To investigate the swelling properties, the dried nanocomposites of similar weight are equilibrated in water at room temperature (30°C) for 4 days to reach the complete swollen state of nanocomposites. Whereas for swelling kinetics, the dried gels are placed in water at 30°C, and their weight is measured at regular time-interval. The excess water on the surface of gels is wiped out prior any gravimetric measurements. The equilibrium swelling ratio and water uptake kinetics of the gels are quantified by the following equations:

$$Swelling\ Ratio = \frac{W_e}{W_d}$$

$$Water\ Uptake\ (\%) = 100 \times \frac{W_t - W_d}{W_s}$$

where W_e, W_d, W_t, W_s are defined as the weight of the water in the completely swollen gel, the weight of the dried gel, the total weight of the partially hydrated gel at time (t) and the weight of water in the completely swollen gel respectively. The swelling time constant, τ_s is estimated by fitting the swelling data to the expression given by Li-Tanaka theory.

$$WU = WU_{max} - A_u \exp\left(\frac{-\mathrm{t}}{\tau_s}\right)$$

where WU_{max} is the maximum degree of water uptake, A_u is the amplitude of water uptake and τ_s is the swelling time constant.

Figure-S1: Analysis of a representative DSC curve with 5˚C scanning heating /cooling rate for nanocomposite, NC-II

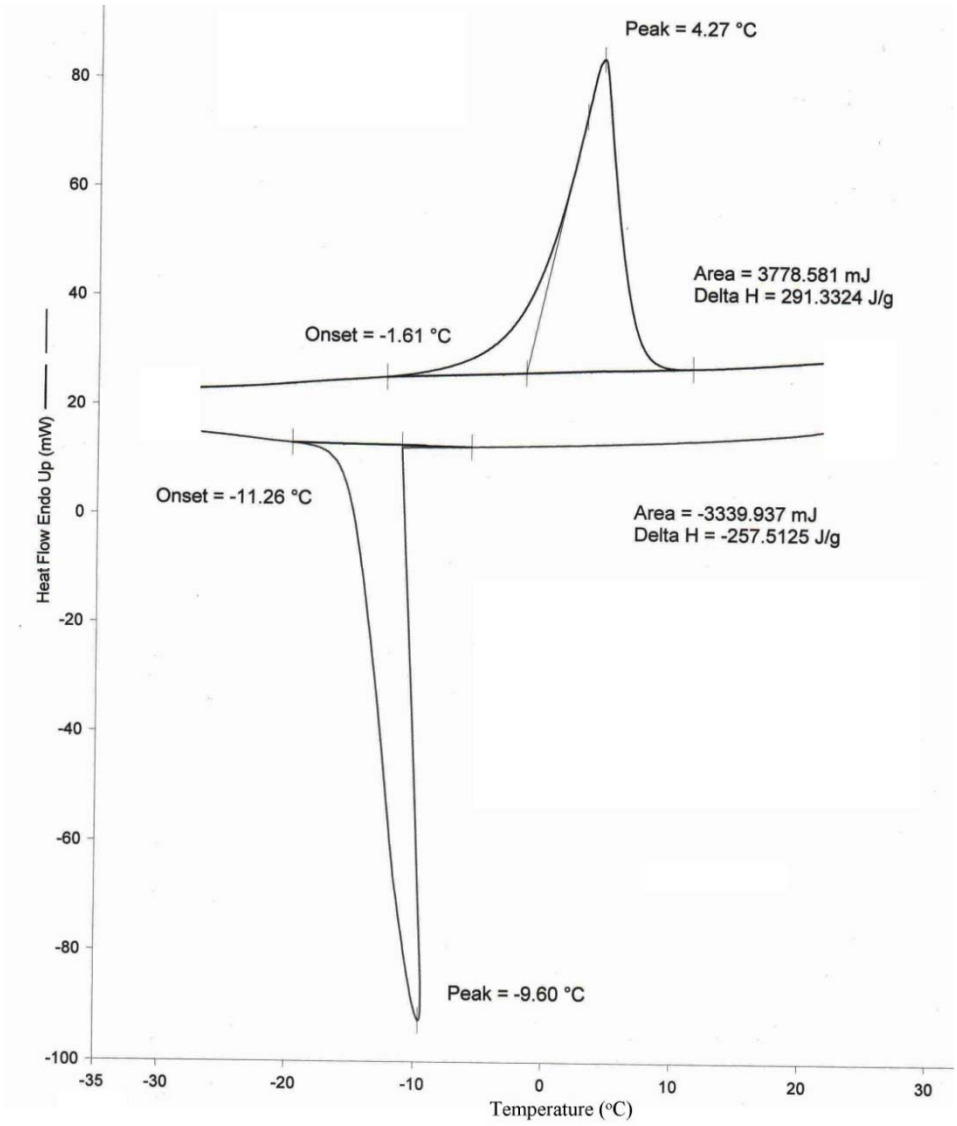


Figure-S2: Absorption spectra of dried nanocomposites, NC-II (red line), NC@1 pM Ag-NP (blue line), NC-I (grey line), and PAM (black line).

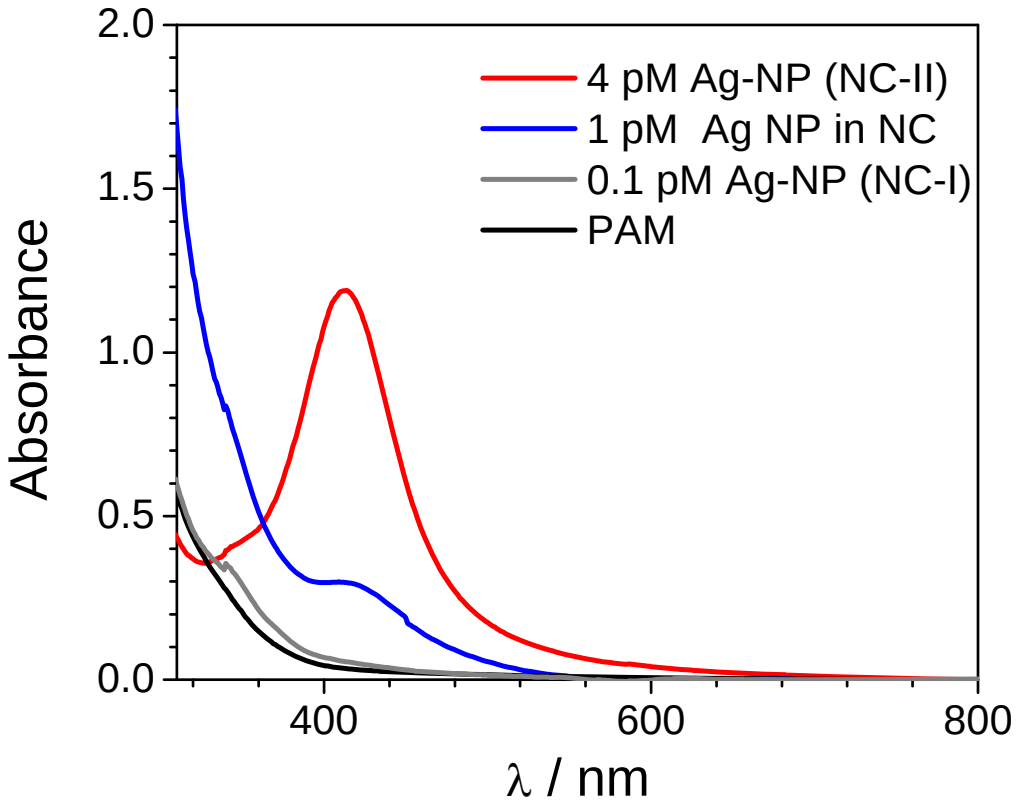


Figure-S3: Absorption spectra of dried nanocomposites, NC-II (red line), Ag-NP in water (blue), PAM @120:1 (grey line).

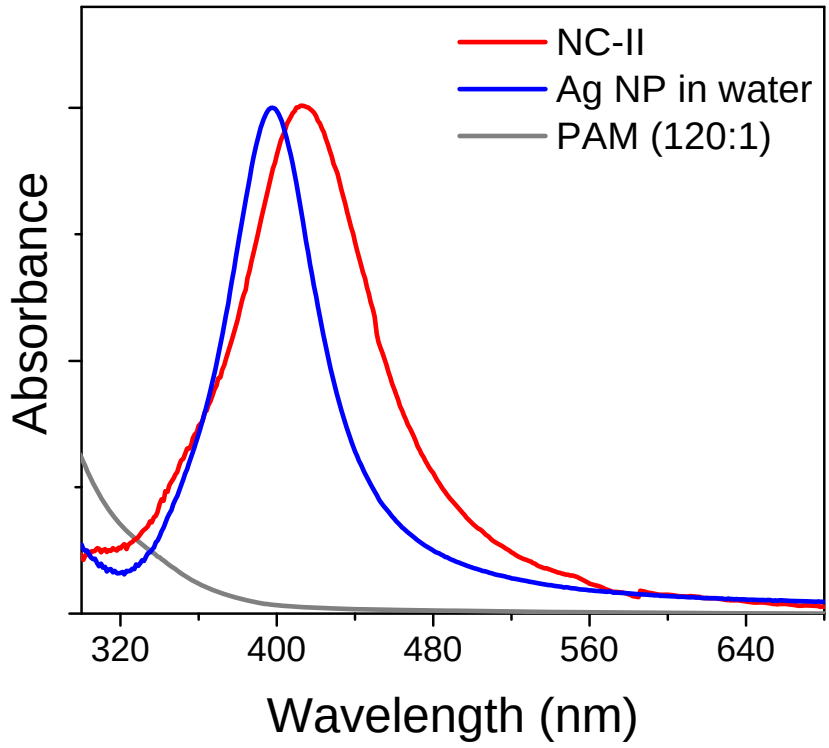


Figure-S4: TEM images (A, and B) of synthesized Ag NP. [C] Size distribution of Ag NPs present in solution.

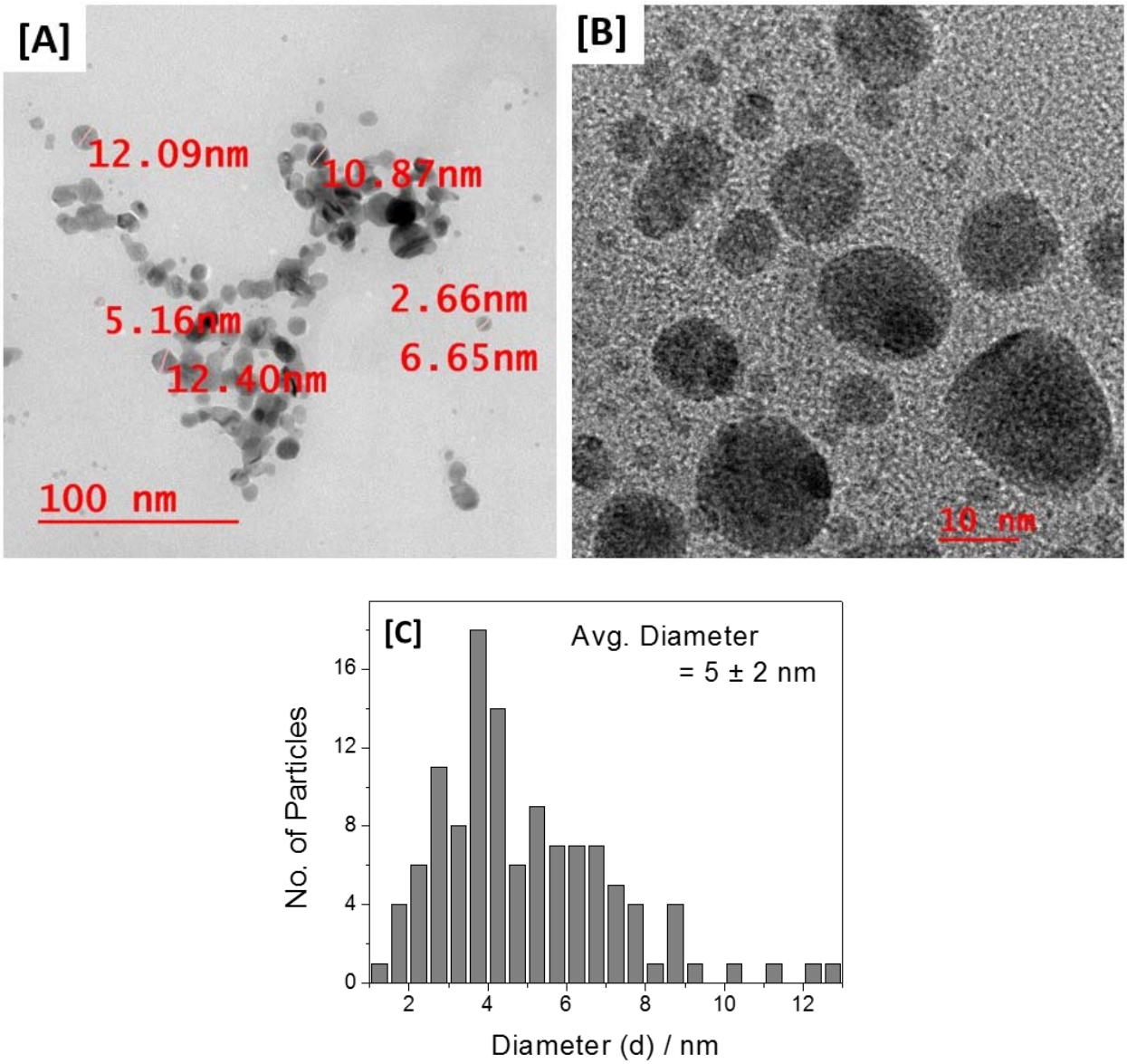
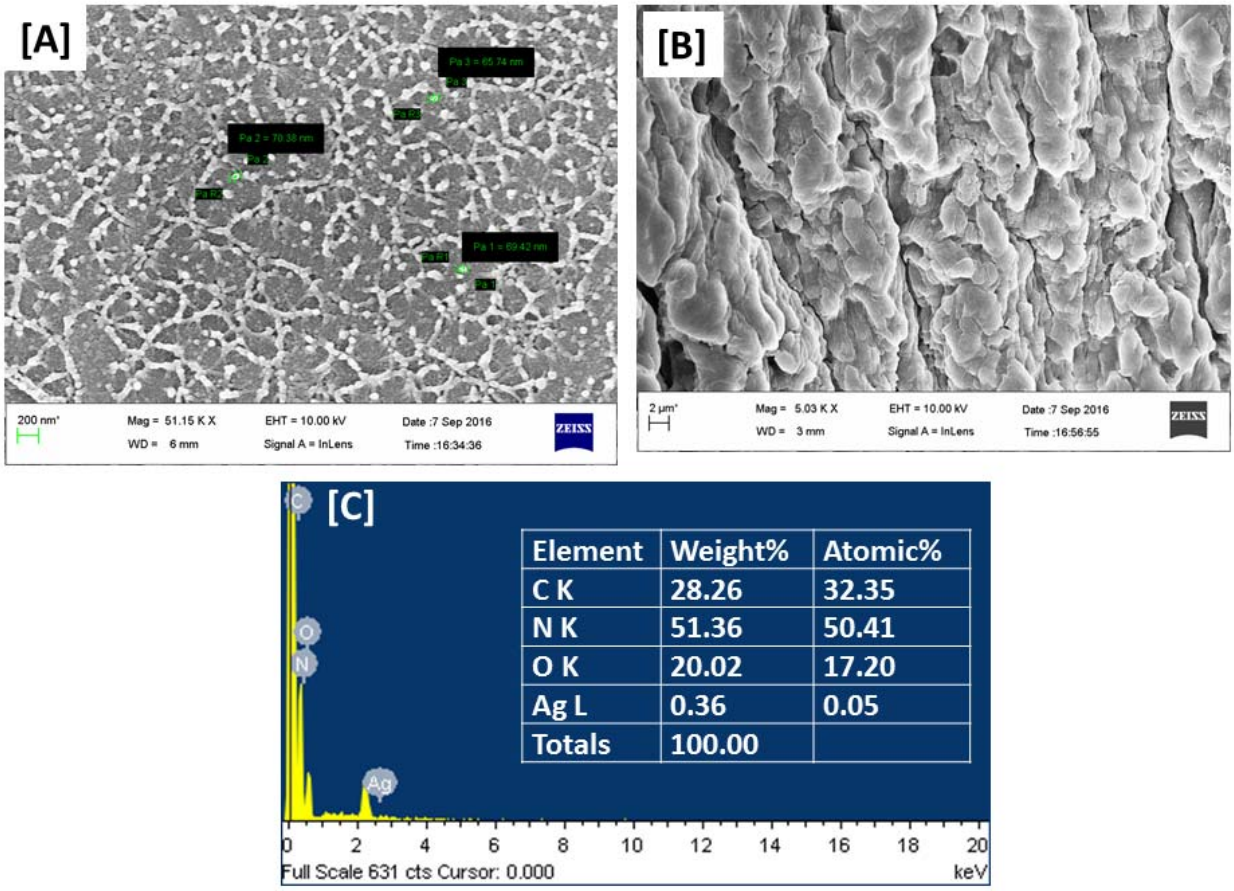


Figure-S5: FESEM images [A, B] showing the microscopic aspect of nanocomposite (NC-II).

[C, D] Energy Dispersive Spectroscopic (EDS) data for nanocomposite (NC-II).



Element	Weight%	Atomic%
C K	28.26	32.35
N K	51.36	50.41
O K	20.02	17.20
Ag L	0.36	0.05
Totals	100.00	

Figure-S6: Plot of temperature difference ($T_m - T_f$) at different swollen state for PAM (square), NC-I (circle), NC-II (triangle) and NC@1 pM Ag-NP (star)

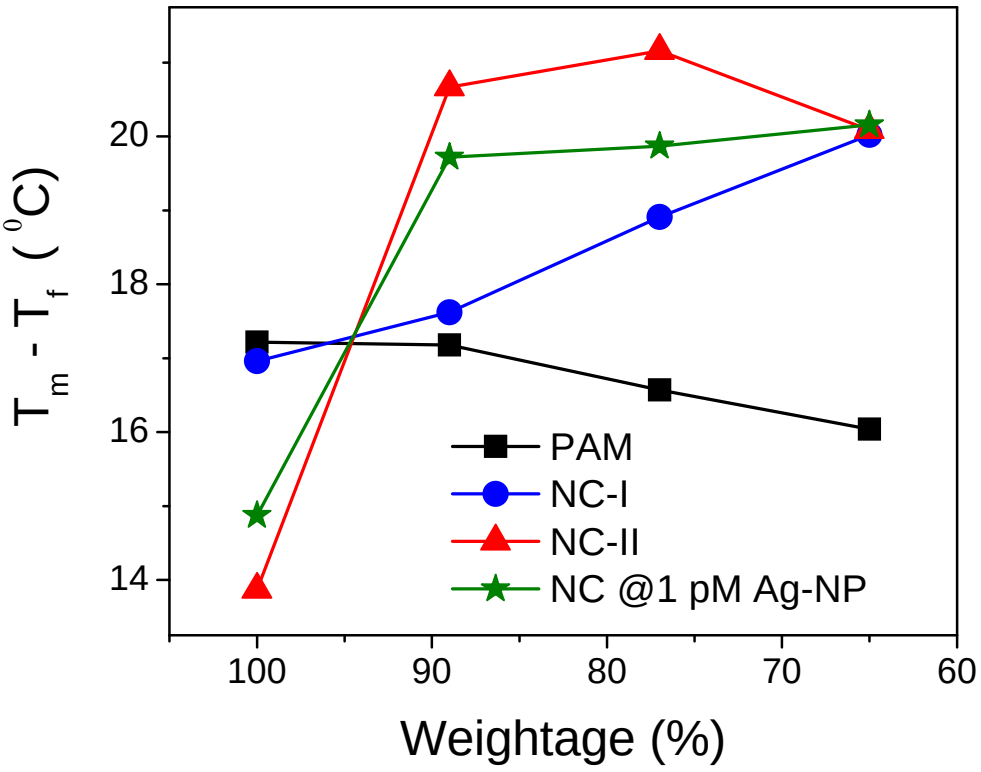


Figure-S7: FTIR spectra of NC-II [A] and PAM [B] recorded at different time interval upon incubation in water. 0 min (black line), 10 min (blue line), 20 min (magenta line), 30 min (green line) and 40 min (red line). The corresponding peaks of amide and carbonyls groups increases as the relative water content increases in the gel network. For NC-II, corresponding amide peak is blue-shifted as the water content increases.

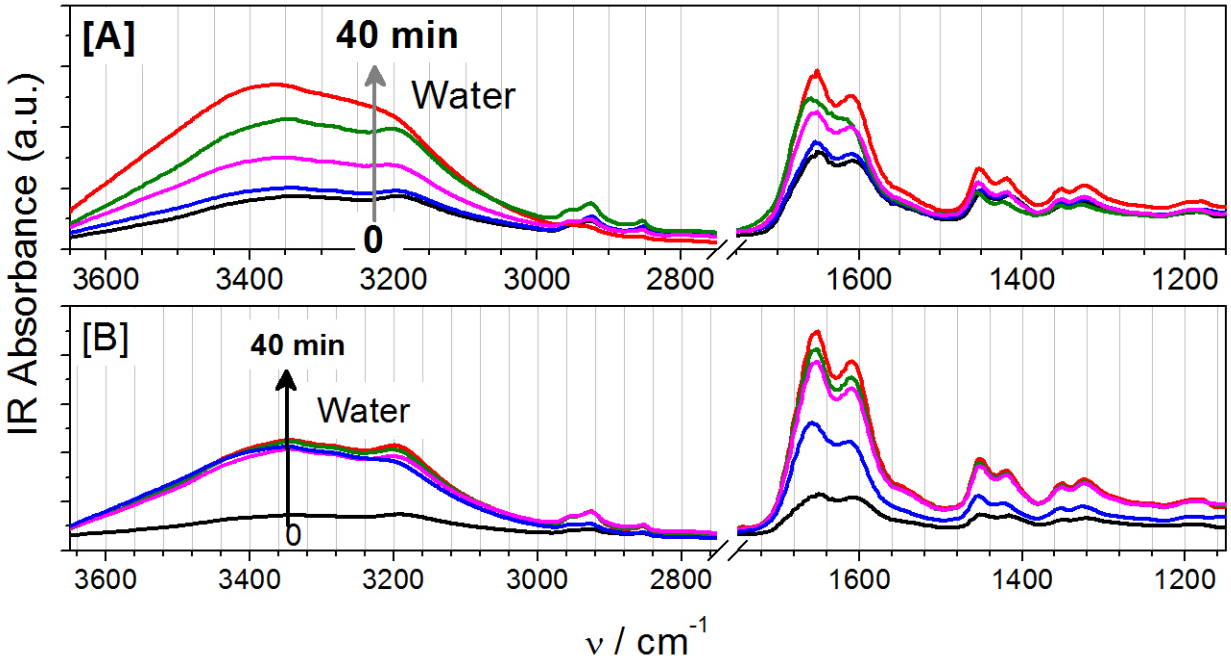


Table-S1: Onset temperatures for melting (O_m)and freezing (O_f) for DSC measurements

W (%)	PAM		NC-I		NC-II	
	O_m	O_f	O_m	O_f	O_m	O_f
100	-2.11	-14.83	-1.42	-14.93	-1.61	-11.26
89	-2.15	-15.74	-1.98	-17.02	-2.06	-19.59
77	-3.14	-16.3	-2.33	-18.85	-2.14	-20.77
65	-4.18	-16.49	-2.7	-20.04	-2.6	-20.61

* Weight percentage (W %) of nanocomposites with respect to its initial weight.
All the temperatures are in °C

Table S2. Thermal properties of the nanocomposite (120:1) measured at different swollen states.

W (%)	PAM (120:1)						NC-III					
	O_m	T_m	λ_m	O_f	T_f	λ_f	O_m	T_m	λ_m	O_f	T_f	λ_f
100	-2.52	4.09	224.87	-18.48	-16.22	-225.47	-2.83	4.38	194.73	-14.09	-12.88	-189.88
89	-2.37	3.68	222.06	-19.49	-17.06	-215.80	-3.57	3.41	177.00	-14.06	-12.81	-181.31
77	-2.75	3.27	207.37	-18.73	-16.05	-199.89	-4.24	2.12	158.54	-14.17	-13.07	-144.13
65	-2.85	2.87	178.98	-20.00	-17.32	-182.92	-5.33	1.14	135.21	-14.97	-13.89	-143.99

* Weight percentage (W %) of nanocomposites with respect to its initial weight.
All the temperatures are in °C and latent heat in kJ/kg.
Onset temperatures for melting (O_m)and freezing (O_f) for DSC measurements