SUPPLEMENTARY INFORMATION

Effect of small amounts of akaganeite (β-FeOOH) nanorods on gelation, phase behaviour and injectability of thermoresponsive Pluronic F127

Surya Narayana Sangitra[a] and Ravi Kumar Pujala[a,b*]

[a] Soft and Active Matter group, Department of Physics, Indian Institute of Science Education and Research (IISER) Tirupati, Andhra Pradesh, 517507, India

[b] Center for Atomic, Molecular and Optical Sciences & Technologies (CAMOST), Indian Institute of Science Education and Research (IISER) Tirupati, Tirupati, Andhra Pradesh, 517507, India

Corresponding author E-mail address: pujalaravikumar@iisertirupati.ac.in

Section S1: Additional calculation for d-spacing from HR-TEM images

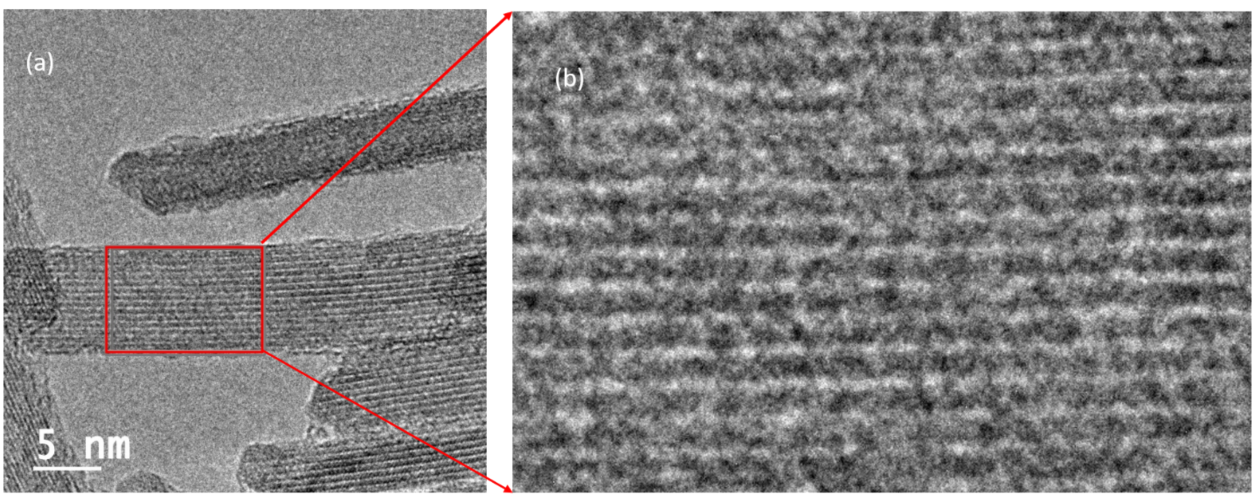

Figure S1: (a) Original HR-TEM image of nanorods with selected is highlighted the region in a red square where the d-spacing is supposed to be calculated (b) cropped area of figure (a)

Step 1: We have identified the region where the d-spacing is calculated, as shown in figure S1.

Step 2: FFT image of the cropped area was taken and identified the brightest spot in the pattern, and the inverse FFT was taken, which almost looks similar to figure S1.1 (b) as shown in figure S1.2

Step 3: A Plot profile is taken along any reference line, as shown in figure S3, and then calculating the no of peaks d-spacing can be determined.

From figure S1.3 (b) total 8 number of peaks are present in the width of 4.5 nm, therefore, the d-spacing is = 4.5/8 =0.5625 nm.

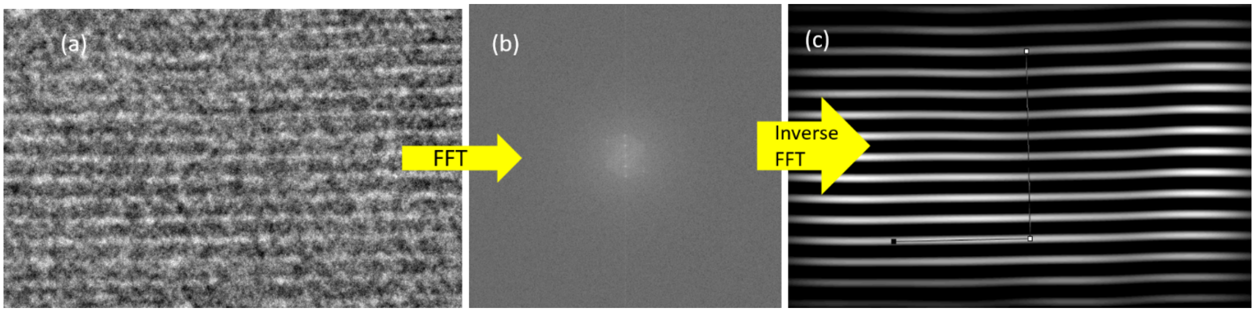

Figure S2: (a) Selected area, (b) FFT image of the figure (a) and inverse FFT of the figure(b).

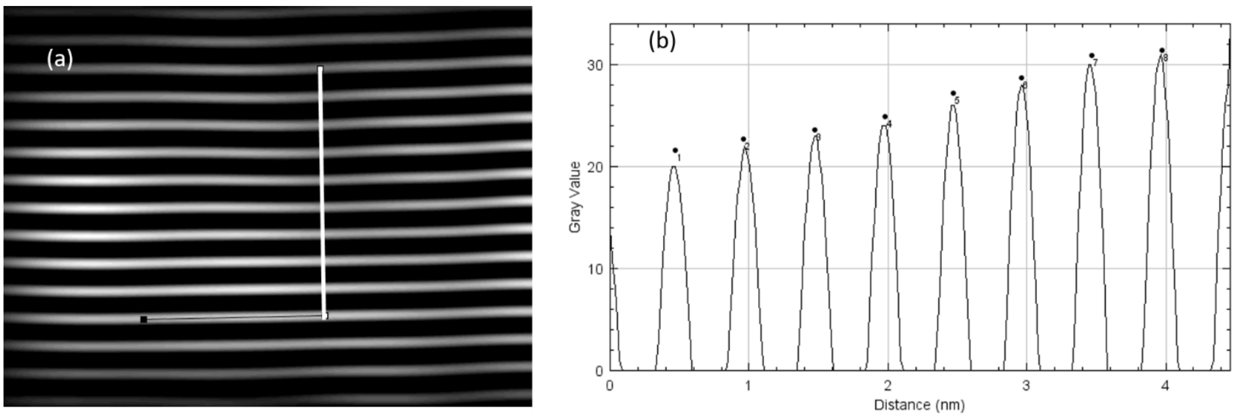

Figure S3: (a) Inverse FFT with a reference line and (b) plot profile along that reference line

Section S2: Energy Dispersive Spectroscopy (EDS)

Table ST1: EDS data for the nanorods

Element	Line Type	k Factor	Absorption Correction	Wt%	Wt% Sigma
O	K series	2.028	1.00	35.56	0.83
Na	K series	1.201	1.00	0.00	0.00
Cl	K series	1.029	1.00	7.78	0.38
Fe	K series	1.136	1.00	56.66	0.81
Total:				100.00	

Section S3: Contact Angle measurements for β-FeOOH NRs

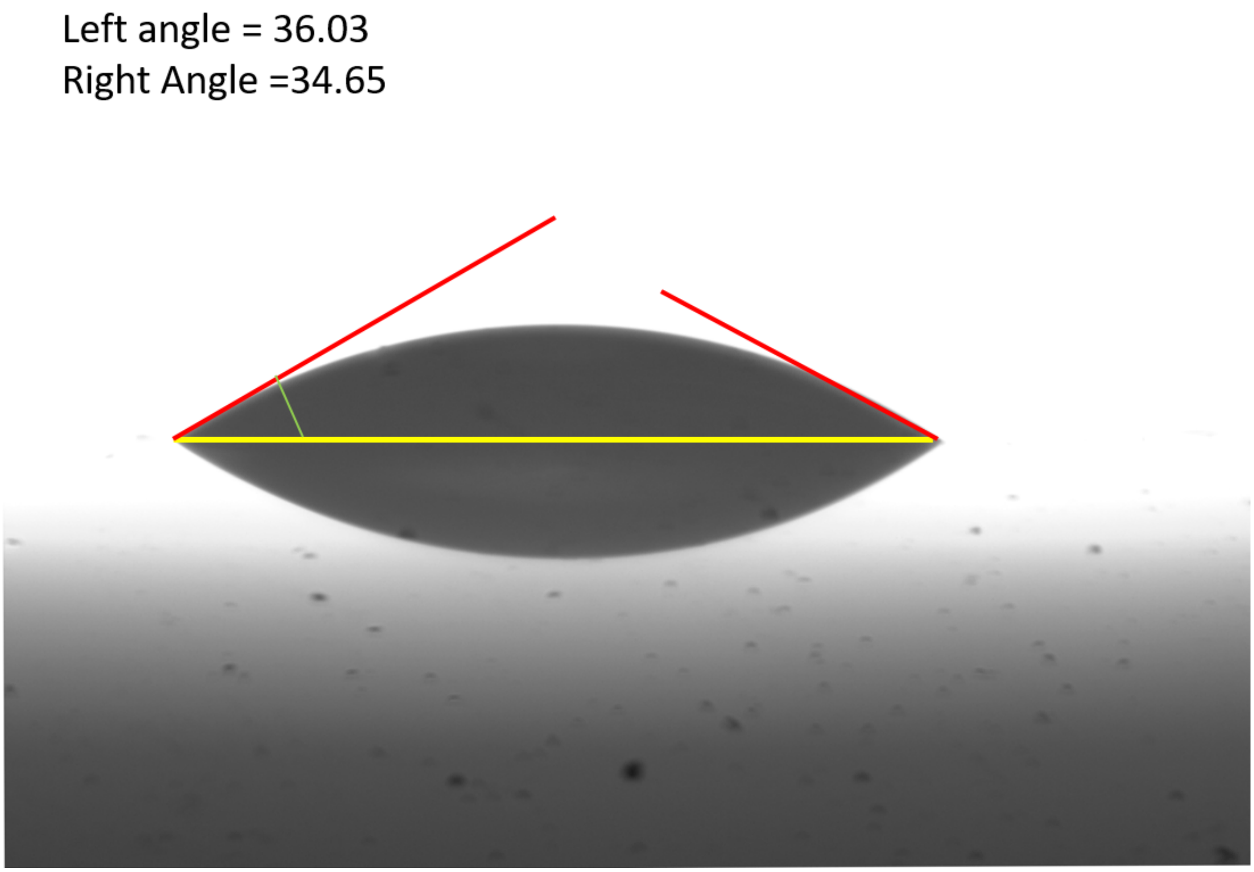

Figure S4: The contact angle measurement is done by placing a water droplet on a β-FeOOH NRs film. The left side and right side angle values are 36.03 ° and 34.65 °, which represents the hydrophilic nature of the β-FeOOH NRs film.

Section S4: Adsorption of PF127 polymers on the nanorods surfaces

Dispersion of β-FeOOH NRs/ PF127- β-FeOOH NRs in aqueous medium

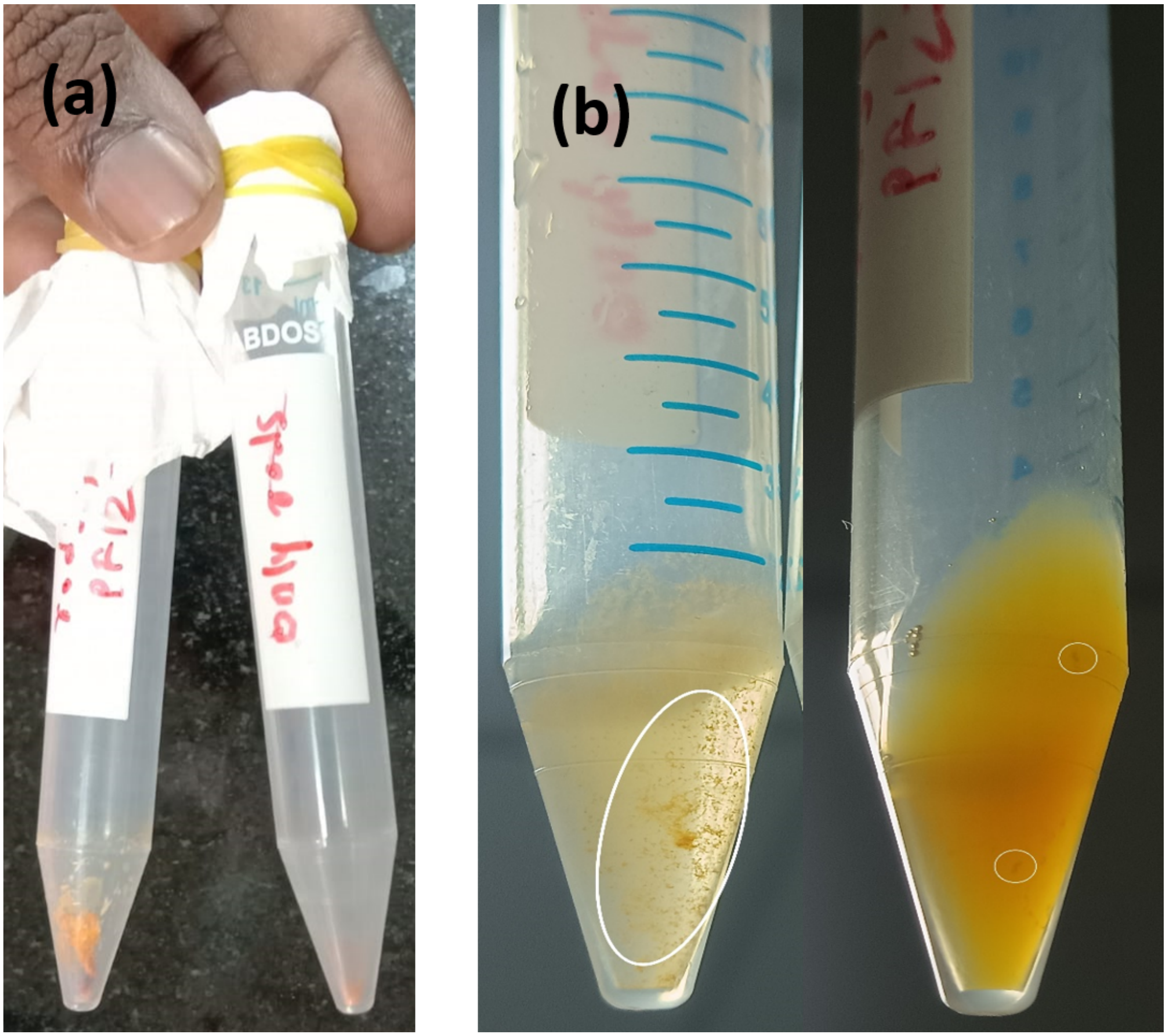

Figure S5: (a) Freeze-dried powder of 0.1% NRs and its composite with PF127 (PF127-NRs) and (b) Re-dispersion of NRs and PF127-NRs in DI water. It can be noted that for both NRs and PF127-NRs composite system cannot redisperse in DI water due to strong hydrophilic interaction and the particle forms aggregates (white circle) seen in Figure b. This can be indication of PF127 get adsorbed on surface of β-FeOOH NRs.

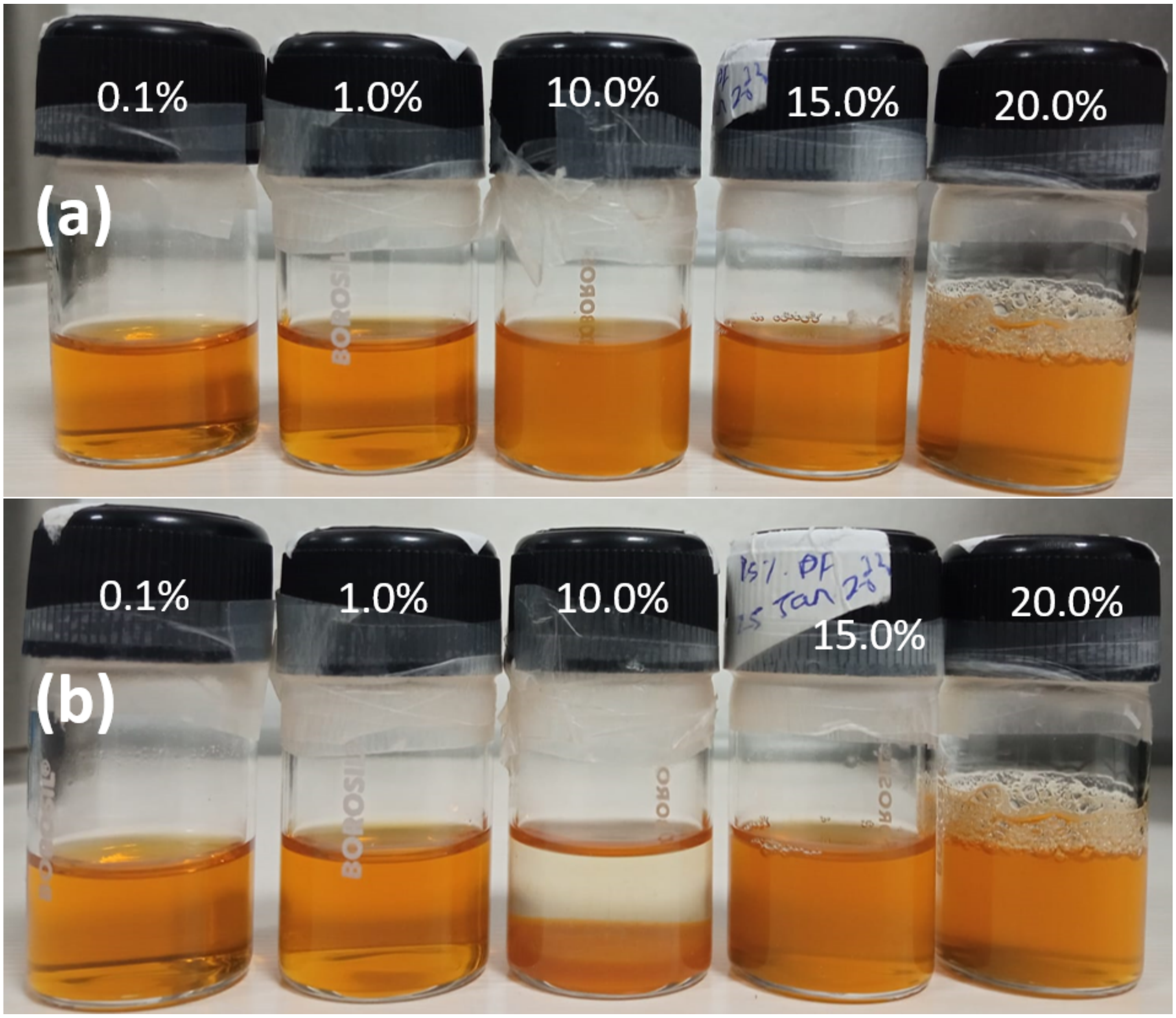

Figure S6: Visual observation of adsorption of PF127 on nanorods surface by observing sedimentation in the composite system for 0.1% (w/v) nanorods and with different concentration of PF127 (a) initial images and (b) is images taken after 25 minutes. The experiment is done at 25^{o}C.

Section S5: Flow curves for the PF127 and composite system at different temperatures

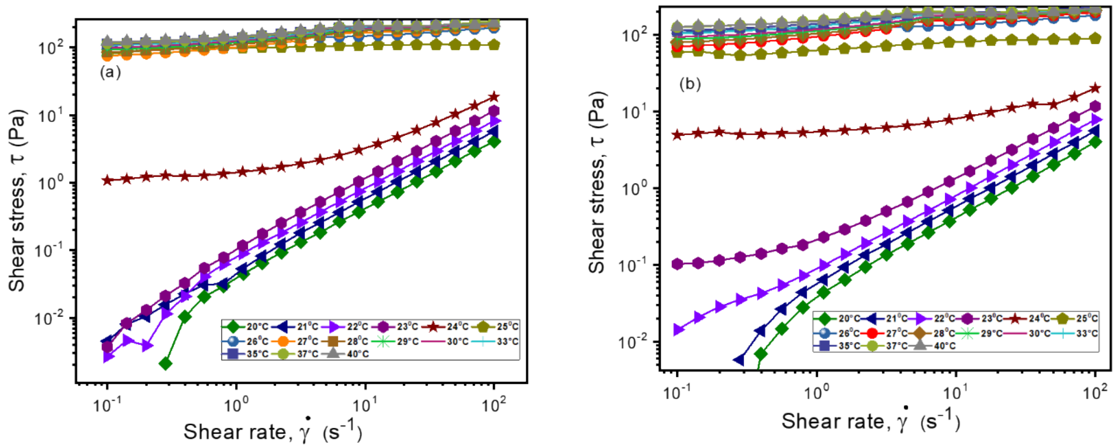

Figure S7: (a) and (b) are the flow curve with shear stress as a function of shear rate for 20%PF127 and composite systems with 0.1% nanorods. Both figures show the clear transition from liquid phase to a gel-like state. Solid lines are guided to the eyes.

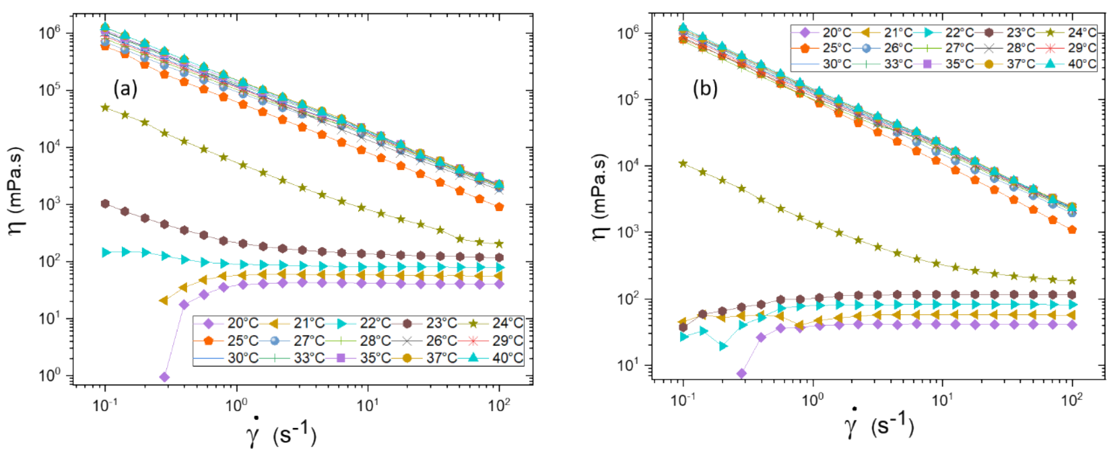

Figure S8: (a) and (b) are the flow curve with viscosity as a function for shear rate for 20%PF127 and composite systems with 0.1% nanorods. The sol-gel transition can be observed at 23^{o}C for 20% PF127 and 24^{o}C for the composite system with 0.1% nanorods. Solid lines are guided to the eyes.

Section S6: Amplitude sweep tests for composite gel samples at different temperatures

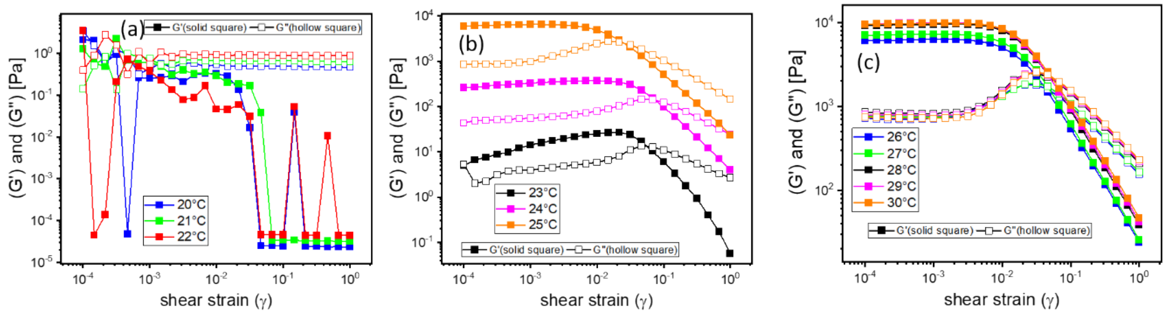

Figure S9: Amplitude sweep data with storage modulus (G') and loss modulus (G") as a function of shear strain (γ) at a constant angular frequency (ω = 10 rad/s) for 20% PF127 at a different temperature from 20-30 °C with 1 °C interval. (a) G" dominated over G' for 20-22 °C which corresponds to liquid-like behaviours. (b) For 23-25 °C, the G' is dominated over G" but each 1 °C change and also that LVR regions are not consistent. Therefore, we define these as a soft-gel regime. (c) For 26-30 °C, G' is dominated over G" with a consistent LVR region, we define these as hard-gels in the manuscript.

Section S7: Frequency sweep tests for composite gel samples at different temperatures

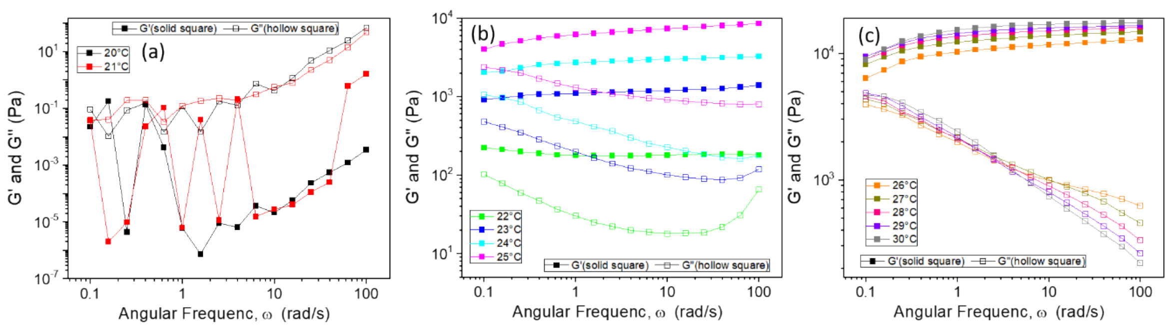

Figure S10: Frequency sweeps with storage modulus (G') and loss modulus (G") as a function of angular frequency (ω) at shear strain (γ) = 0.1% and for 20% PF127 at different temperatures from 20-30 °C with 1 °C interval. (a) G" dominated over G' for 20-21 °C which corresponds to liquid-like behaviors. (b) For 22-25 °C, the G' is dominated over G" but we see a significant change in values even if we change only 1 °C interval, therefore we define these as soft-gel regime. (c) For 26-30 °C, G' is dominated over G" with identical trends, so we define these as hard-gels in the manuscript.

Section S8: Evaluation of yield stress from Amplitude sweep tests for composite gel samples at different temperatures

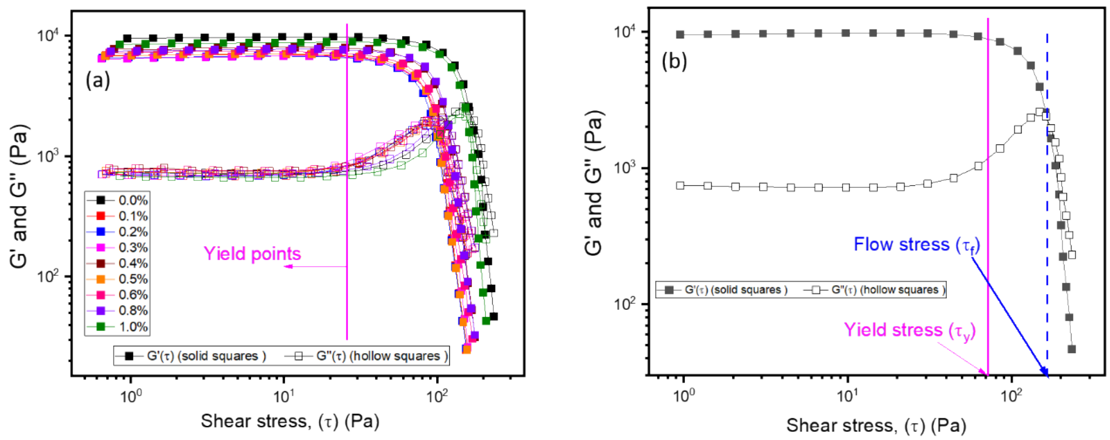

Figure S11: (a) Amplitude sweep data with storage modulus (G') and loss modulus (G") as a function of shear stress (τ) at a constant angular frequency (ω = 10 rad/s) for different concentrations at 30 °C for 20 % PF127 and for composites with different concentration of β -FeOOH nanorods (b) we defined yield stress (τ_y), flow stress (τ_f). Solid lines in both figures (a) and (b) are guided to the eye.