

## Supplementary Material: Quasielastic neutron scattering reveals the temperature dependent rotational dynamics of densely grafted oleic acid.

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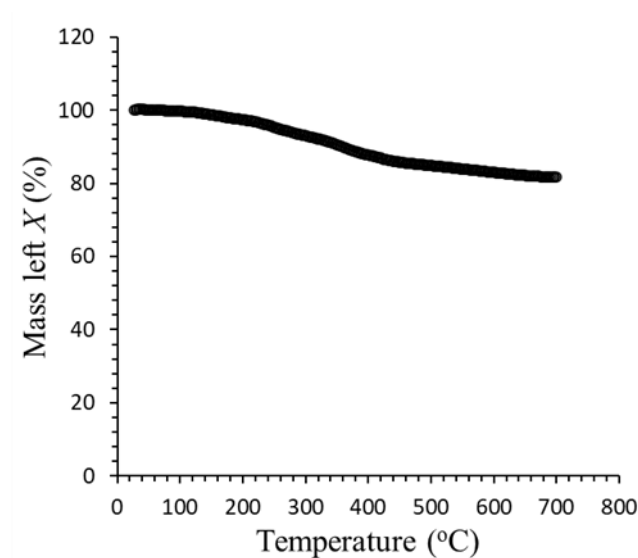
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### Thermogravimetric analysis and grafting density calculations:

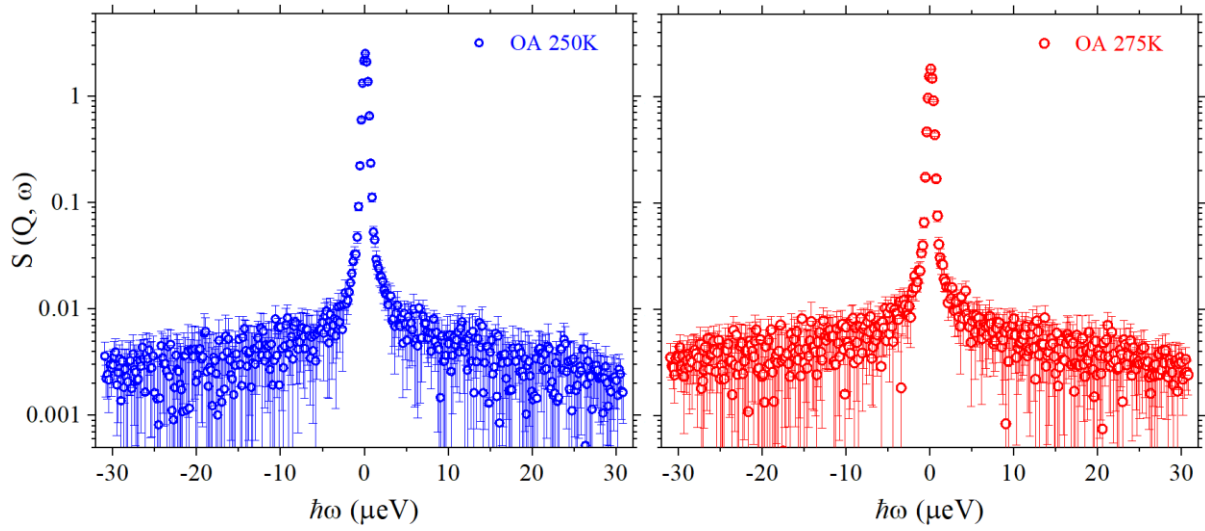


**Figure S1.** Mass loss data from thermogravimetric analysis of oleic acid grafted iron oxide nanoparticles.

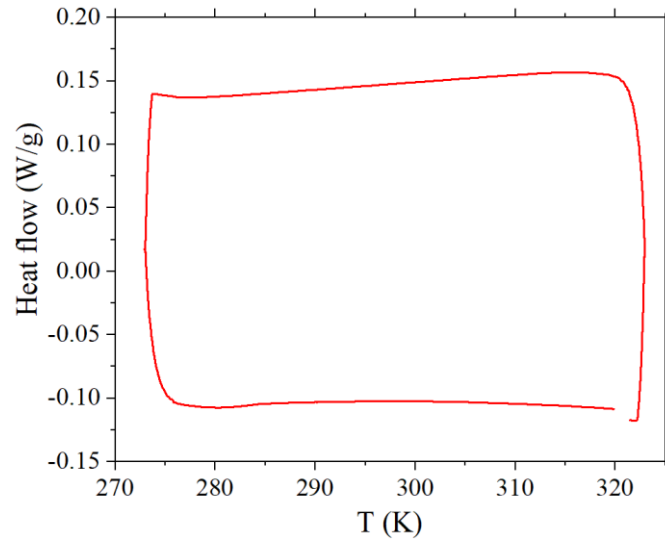
In order to calculate the grafting density, we use the following formula:

$$\sigma = \frac{r \rho N_A (100 - X)}{3 M X}$$

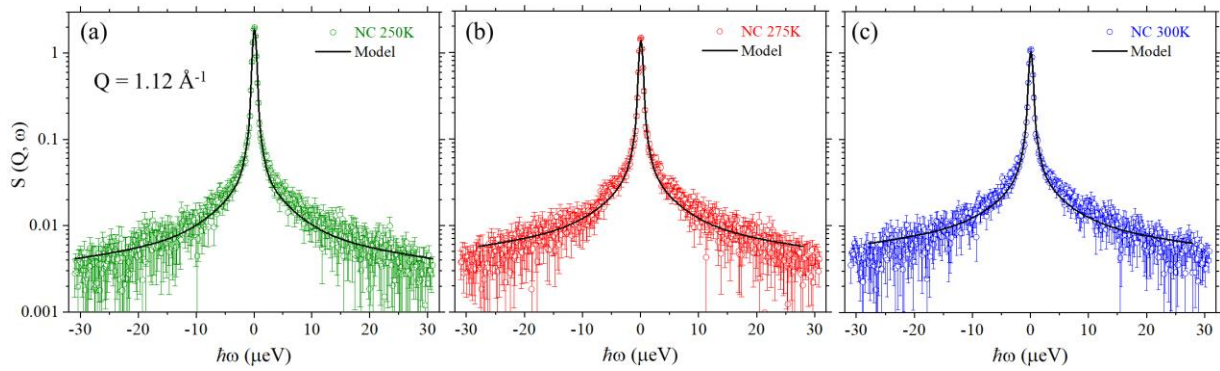
Where,  $\sigma$  is the grafting density in chains/nm<sup>2</sup>,  $r$  (nm) and  $\rho$  (g/nm<sup>3</sup>) are the radius and density of the nanoparticle,  $N_A$  is Avogadro's number,  $X$  is percentage mass left and  $M$  (g/mol) is molecular weight of oleic acid.



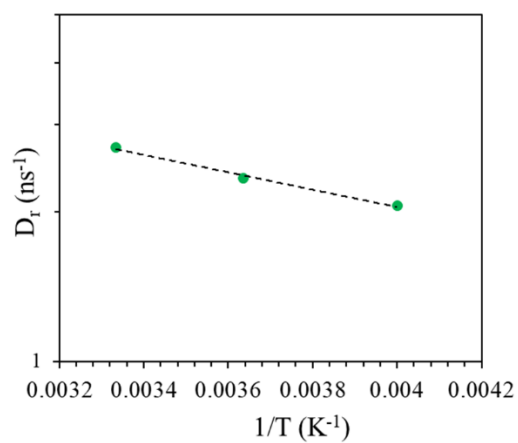
**Figure S2.** Neutron backscattering spectra obtained from oleic acid at 250 K and 275 K show only elastic scattering due to crystallization of oleic acid.



**Figure S3.** Differential scanning calorimetry data obtained from oleic acid grafted on iron oxide nanoparticles shows no signature of phase transition in second heat (heating rate = 10°C/min).



**Figure S4.** Representative fits from backscattering spectra of grafted oleic acid nanocomposite at  $Q = 1.12 \text{ \AA}^{-1}$  at three different temperatures (a) 250 K (b) 275 K (c) 300 K. Black line represents the fit obtained using KWW model.



**Figure S5.** Temperature dependent rotational diffusivities of grafted oleic acid. Dashed line represents an Arrhenius fit with activation energy = 3.3 kJ/mol.