Electronic Supplementary Material (ESI) for RSC Advances.

Electronic Supporting Information (ESI)

Effect of Graphene on Self-assembly and Rheological Behavior of a Triblock Copolymer Gel

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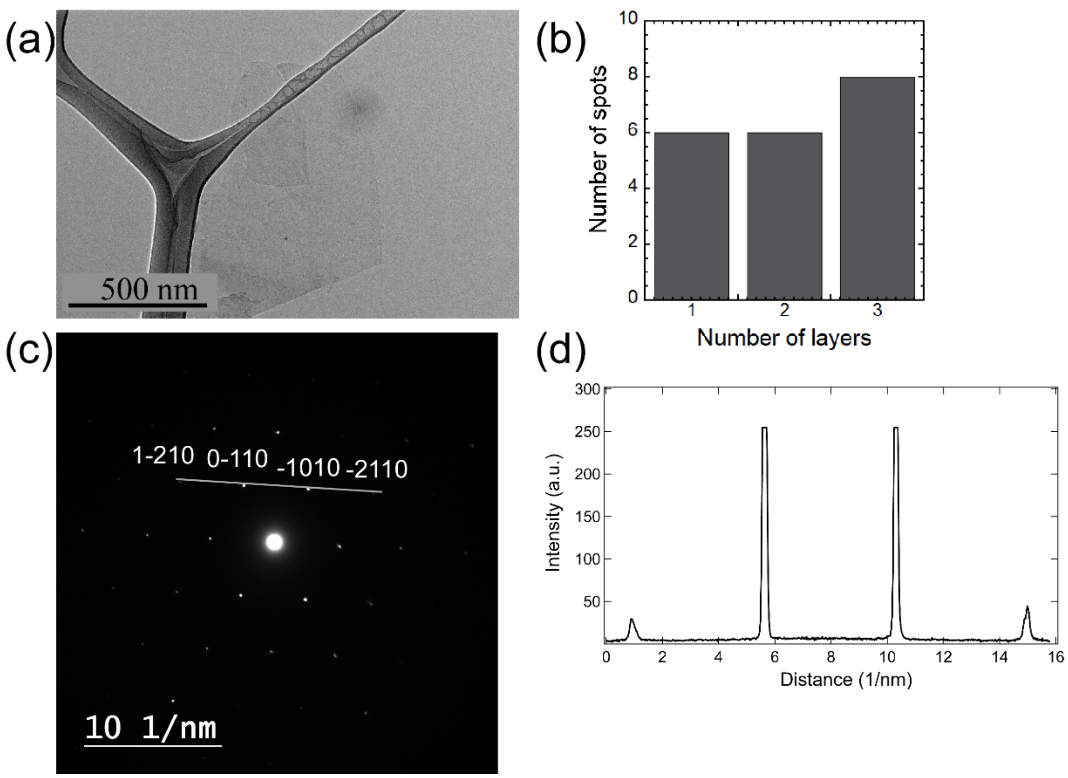

Fig. S1 (a) TEM image of a single layer graphene dispersed in 2-ethyl-1-hexanol (graphene concentration of 0.04 mg/mL). The number of graphene layers is counted at 20 different spots and the distribution is shown in (b). The electron diffraction pattern of platelet shown in (a) is presented in (c). The intensity profile of {1100} and {2110} is shown in (d). The intensity ratio, I_{1100}/I_{2110} = 6.25 (greater than 1) indicating single layer of graphene.

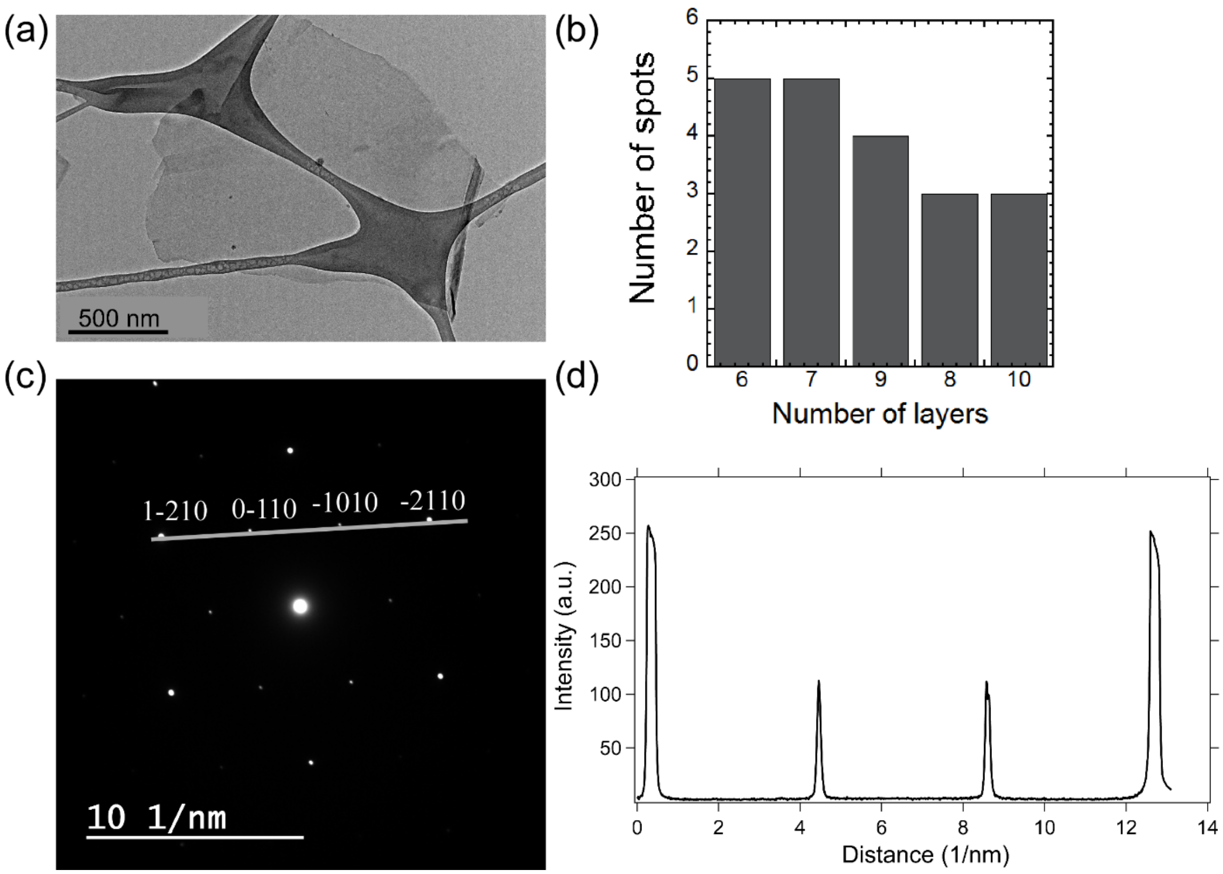

Fig. S2 (a) TEM images of FLG graphene dispersed in 2-ethyl-1-hexanol (graphene concentration of 0.12 mg/mL). The number of graphene layers is counted at 20 different spots and the distribution is shown in (b). The electron diffraction pattern of platelet shown in (a) is presented in (c). The intensity profile of {1100} and {2110} is shown in (d). The intensity ratio, I_{1100}/ I_{2110} = 0.4 indicating multilayer of graphene.

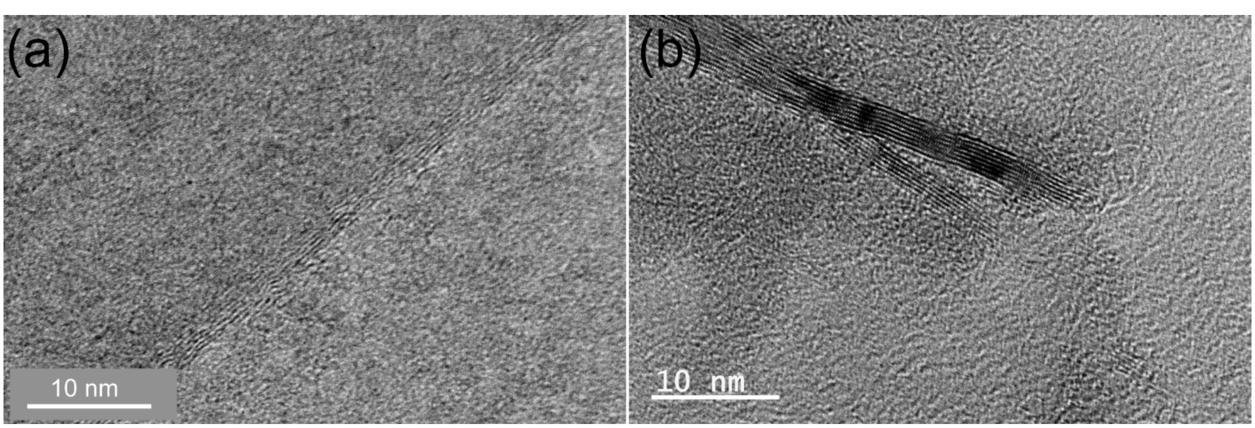

Fig. S3 (a) and (b) TEM images of multilayers of graphene dispersed in 2-ethyl-1-hexanol (graphene concentration of 0.12 mg/mL).

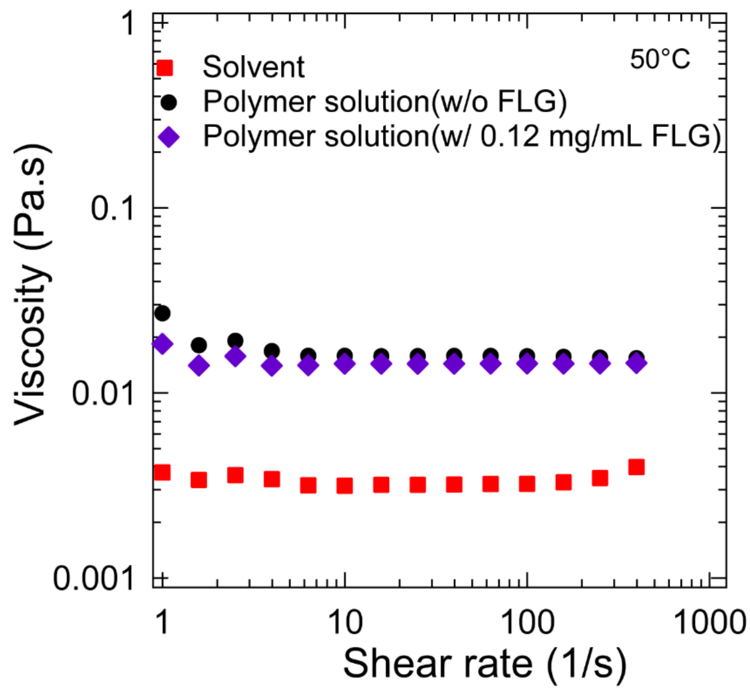

Fig. S4 Viscosity vs shear rates at 50 °C

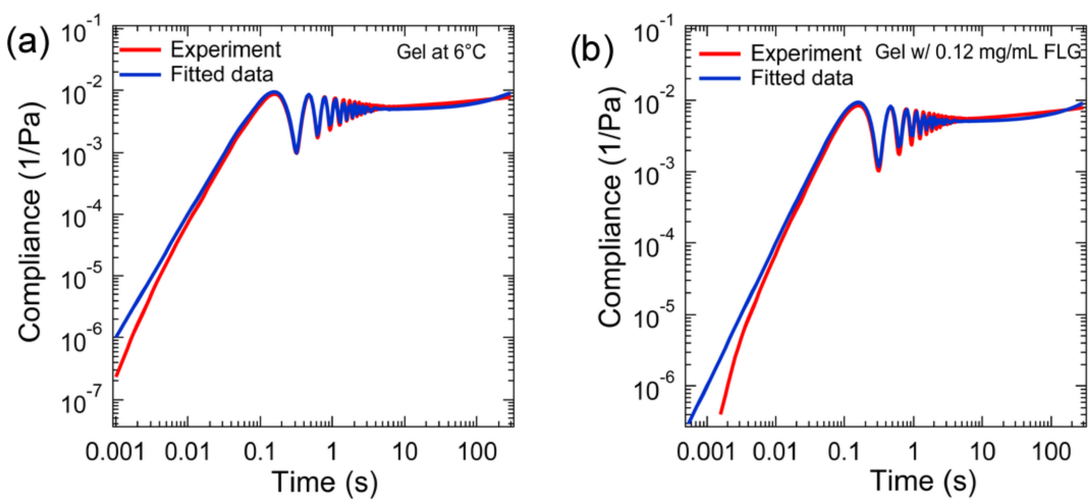

Fig. S5 Creep response of gel without (a) and with 0.12 mg/mL of graphene (b).

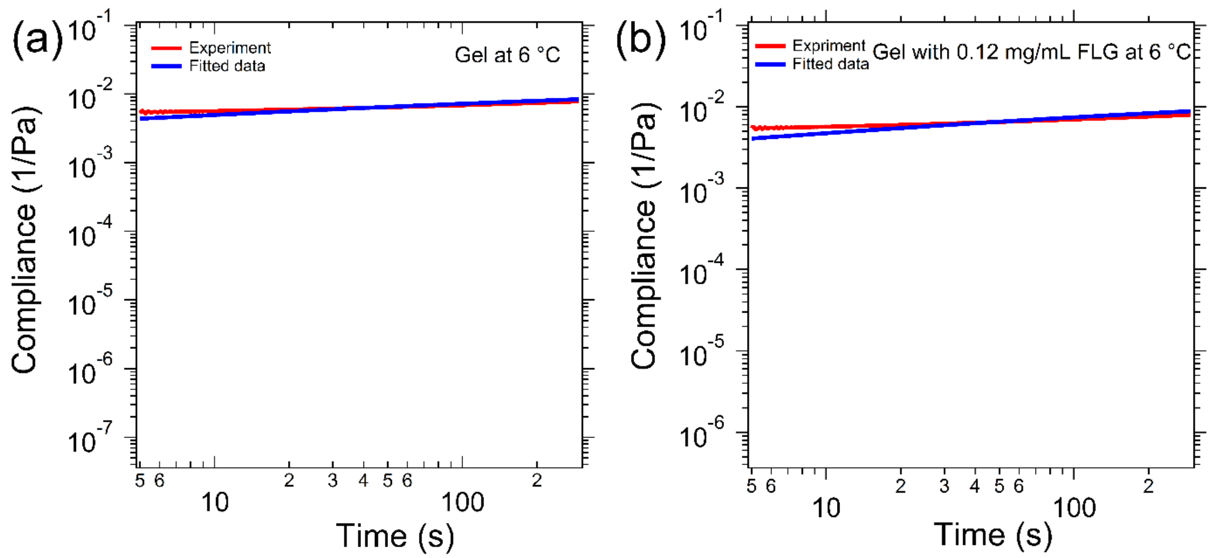

Fig. S6 Non-ringing region of creep response of (a) gel without and (b) with 0.12 mg/mL graphene fitted with stretched exponential model.

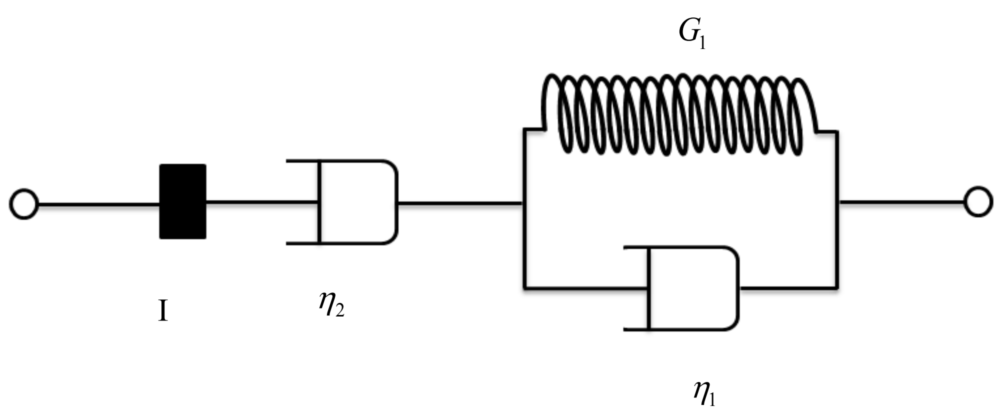

Fig. S7 Viscoelastic Maxwell-Jeffreys model consist of springs (G_1), dashpots (η_1 and η_2) and inertial terms (I)

We fit the data with viscoelastic solid model in linear region using Jeffreys model. The inertia term which is related to the moving part of the rheometer was added to this model to capture the short-term response, long term response and creep ringing behavior. The viscoelastic Jeffreys model and its corresponding mathematical equation composed of springs (G_1), dashpots (η_1 and η_2) and inertia terms (I) is shown in Eq. 1[1]

$$J(t) = (\frac{t}{\eta_2} - B + \exp(-At)[B\cos(\omega t) + \frac{A}{\omega}(B - \frac{1}{A\eta_2})\sin(\omega t)] \tag{1}$$

Where $A = \dfrac{G + \eta_1\eta_2 \frac{b}{I}}{2(\eta_1 + \eta_2)}$ $\quad B = \dfrac{\eta_1 + \eta_2}{G_1\eta_2}\left(\dfrac{2AI}{\eta_2 b} - 1\right)$ $\quad \omega = \sqrt{\dfrac{G_1 \frac{b}{I}\frac{\eta_2}{(\eta_1 + \eta_2)} - A^2}{I}}$

$I = I_{\text{Instrument}} + I_{\text{Geometry}}$, $\text{b (Parallel plate)} = \dfrac{\pi R^4}{2h}$

As given the manufacturer, the total inertia is 23.60742 μN.m.s^2. However, the inertia of 19.175 μN.m.s^2 can capture the ringing better.

Furthermore, the creep data was fitted in long term using the equation having the specific form:[2]

$$J(t) = J_0\left(1 - \exp\left(-\left(\frac{t}{\tau}\right)^{\beta}\right)\right) \tag{2}$$

Here, the data (Fig. S5) was fitted using the same values of τ, and β obtained from fitting of the stress- relaxation data. However, a different value of $G_0 \approx 77$ was obtained here.

References:

1 L. Pavlovsky, J. G. Younger and M. J. Solomon, *Soft Matter*, 2012, **9**, 122–131.
2 K. S. Fancey, *J. Polym. Eng.*, 2001, **21**.