Supporting Materials for

Epoxy Resin Nanosuspensions and Reinforced Nanocomposites with Polyaniline Stabilized Multi-Walled Carbon Nanotubes

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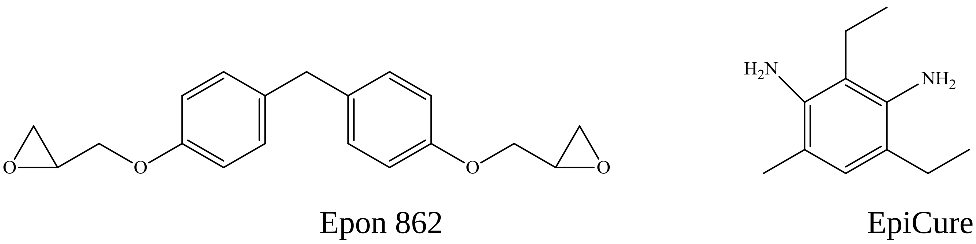

Scheme S1 Molecular structure of Epon 862 and Epicure W curing agent.

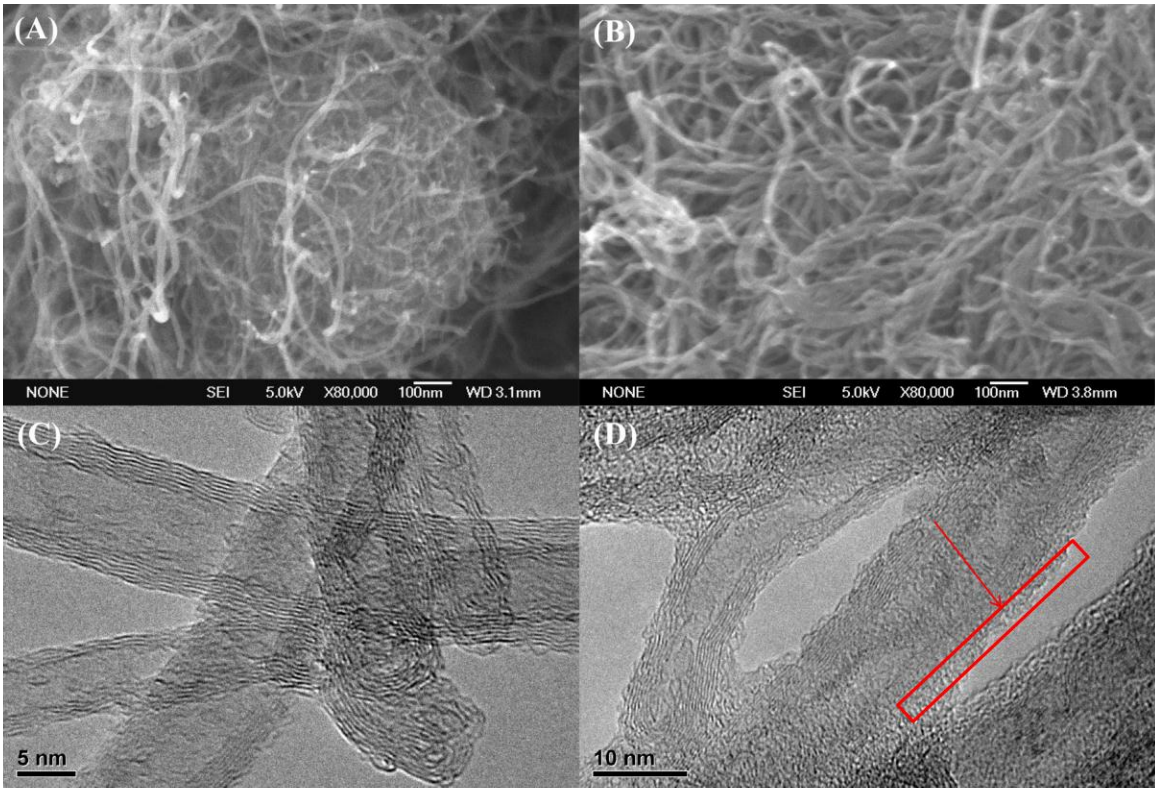

Figure S1 SEM images of **(A)** u-MWNTs, **(B)** f-MWNTs; and TEM images of **(C)** u-MWNTs, **(D)** f-MWNTs.

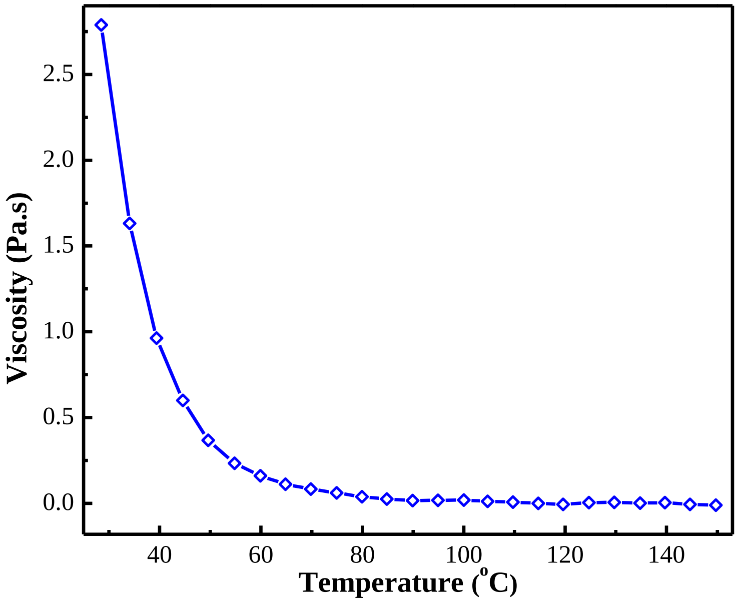

Figure S2 Viscosity *vs.* temperature of epoxy resin monomers (epon 862).

Complex viscosity

Effect of f-MWNTs loading

Figure S3(a) shows the $\eta*$ as a function of frequency for pure epoxy resin and its suspension with the different f-MWNT loadings at room temperature. The pure epoxy resin is observed to have no frequency dependence, exhibiting the Newtonian flow behavior. The epoxy suspension with 0.1 wt% f-MWNTs also shows the frequency independent properties (Newtonian fluid). However, the $\eta*$ of epoxy resin suspensions with f-MWNTs decreases with increasing frequency. When the frequency becomes higher, the difference of $\eta*$ is diminished and reaches the equilibrium value, which indicates the Newtonian behavior of the suspension at higher frequency rather than filler dominating fluid dynamics. This is also observed in the epoxy resin suspended with in situ-stabilized carbon nanofibers reinforced epoxy system.[1]

Effect of functionalization

The η^* of epoxy resin suspended with 0.1 wt% u-MWNTs and f-MWNTs at room temperature is shown in Figure S3(b). The u-MWNT epoxy suspension shows higher η^* and shear thinning behavior with increased frequency. However, for the f-MWNTs epoxy suspension, the reduced η^* is observed and is almost constant, exhibiting the Newtonian fluid property, indicating that the functionalization can introduce a “soft layer” to prevent the agglomeration of MWNTs and improve the dispersion of MWNTs in the polymer matrix.

Effect of temperature

Figure S3(c) shows the effect of temperature on the η^* of epoxy suspensions with 0.3 wt% u-MWNTs and f-MWNTs. The η^* is almost the same for the u-MWNT and f-MWNT epoxy suspensions at 25 ^{o}C. The η^* for epoxy suspensions with u-MWNTs and f-MWNTs increases with increasing temperature. However, at low frequency (<10 rand/s), the difference of η^* between f-MWNT epoxy suspension and u-MWNT epoxy suspension becomes obvious as temperature increases, the η^* of f-MWNT epoxy suspension is higher than that of u-MWNT epoxy suspension, especially for the f-MWNT epoxy suspension at 120 ^{o}C, the η^* increases dramatically (almost 10 times compared with that of u-MWNTs epoxy suspension). This indicates that there is an interaction between PANI layer of f-MWNTs and epoxy matrix. The interconnected network is formed and restricts the relative motions of f-MWNTs and epoxy resion, thus an increased η^* is observed, which also confirms the results obtained in viscosity as a function of shear rate.

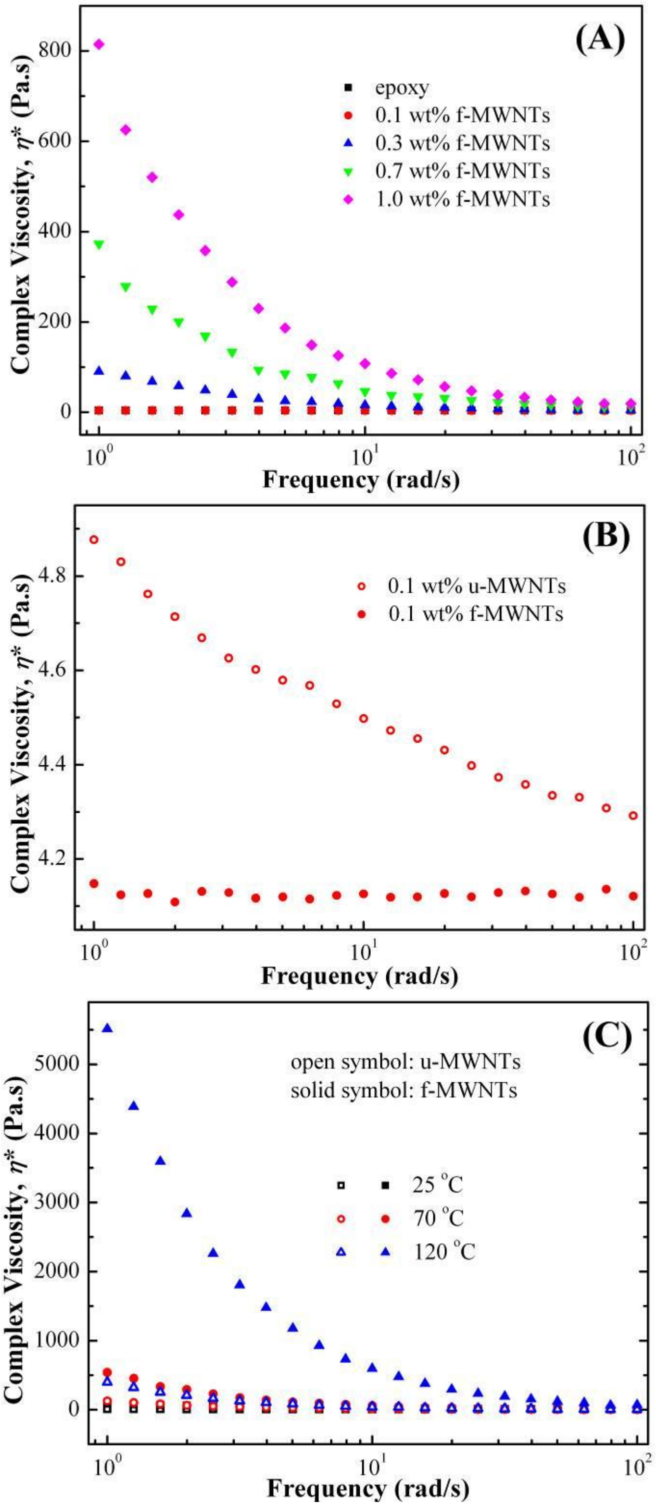

Figure S3 (A) Complex viscosity *vs.* frequency of epoxy suspensions filled with different loadings of f-MWNTs at 25 ^{o}C; **(B)** effect of surface functionalization on the viscosity of epoxy suspension with 0.1 wt% u-MWNTs and f-MWNTs under different shear rate at 25 ^{o}C; **(C)** effect of temperature on the viscosity of epoxy suspensions with a MNWT loading of 0.3 wt%.

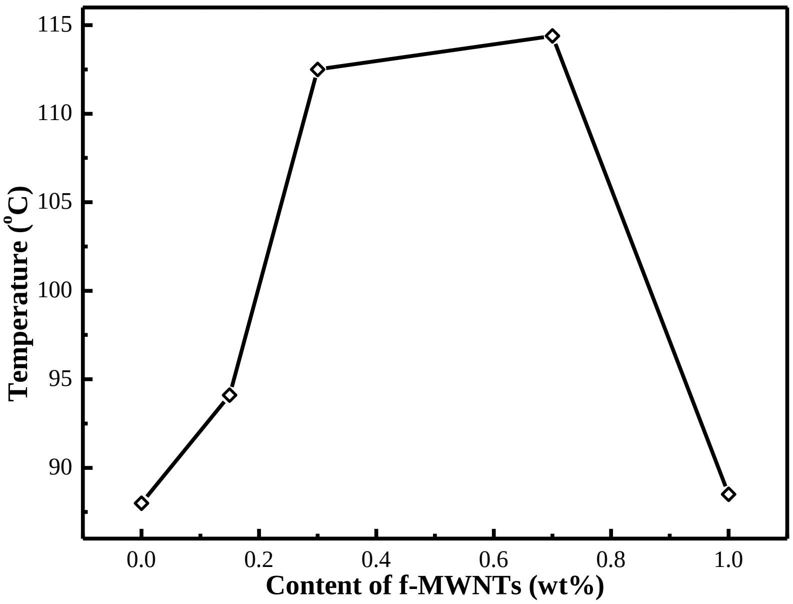

Figure S4 Glass transition temperature (T_g) as a function of f-MWNT loading.

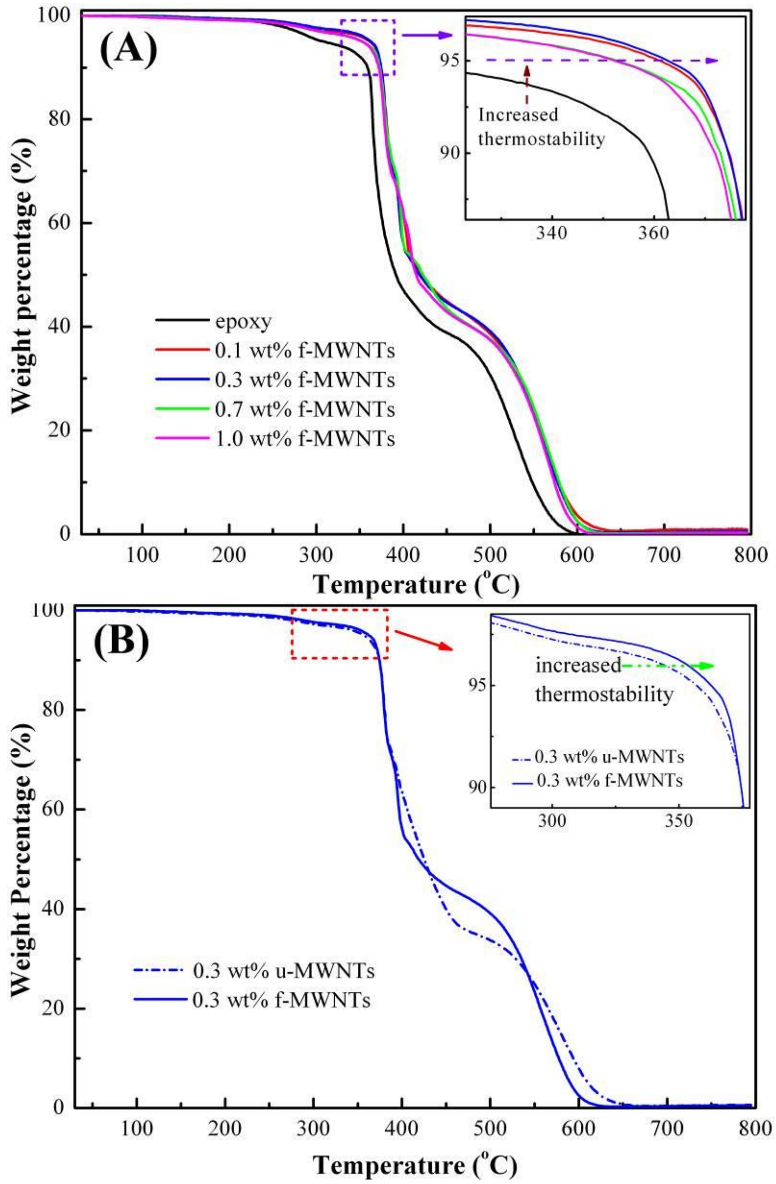

Figure S5 TGA curves of **(A)** cured f-MWNT PNCs with different f-MWNT loadings and **(B)** PNCs filled with 0.3 wt% u-MWNTs and f-MWNTs.

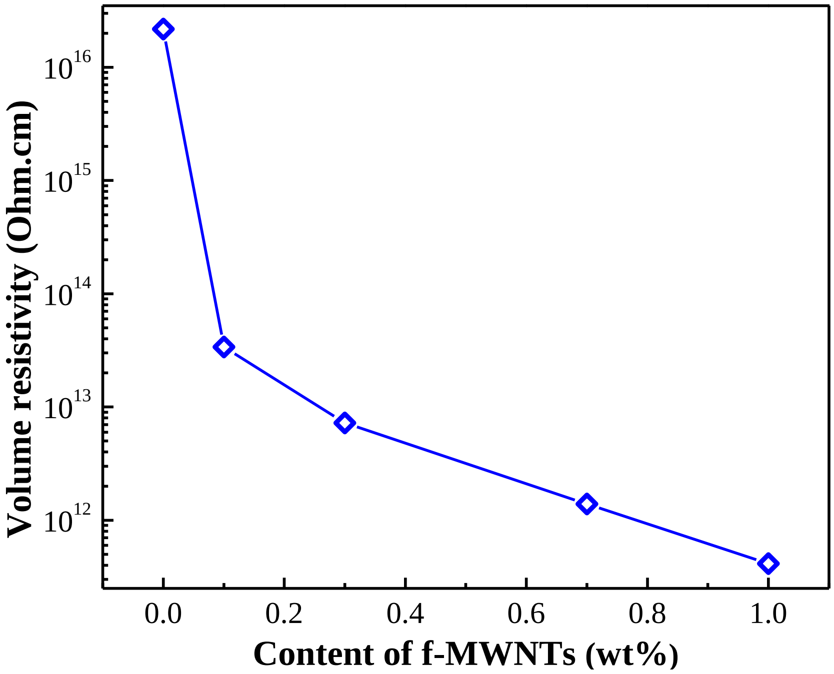

Figure S6 Volume resistivity of cured epoxy and its PNCs filled with f-MWNTs.

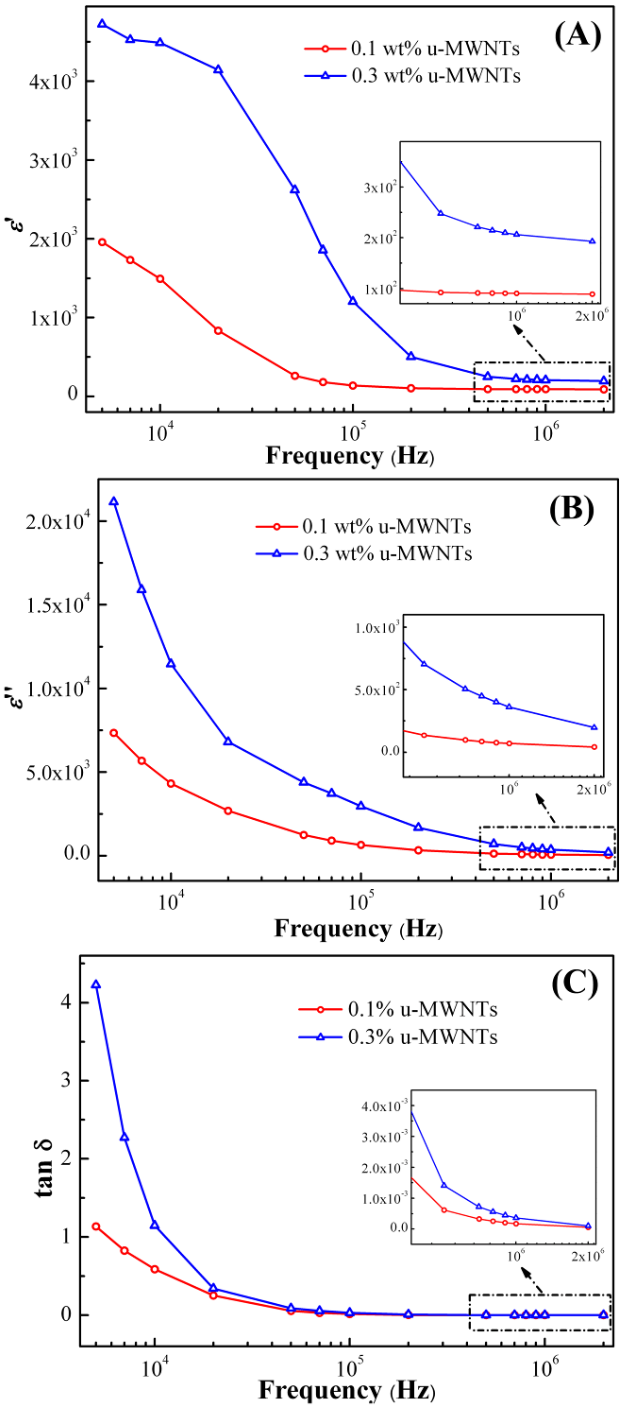

Figure S7 **(A)** real permittivity (ε'), **(B)** imaginary permittivity (ε'') and **(C)** dielectric loss tangent (tanδ) as a function of frequency for cured epoxy PNCs with different u-MWNTs loadings.

[1] J. Zhu, S. Wei, A. Yadav and Z. Guo, *Polymer*, 2010, **51**, 2643-2651.