Supplementary Information

Effect of high filler loading on polymer/(reduced) graphene oxide nanocomposite coatings

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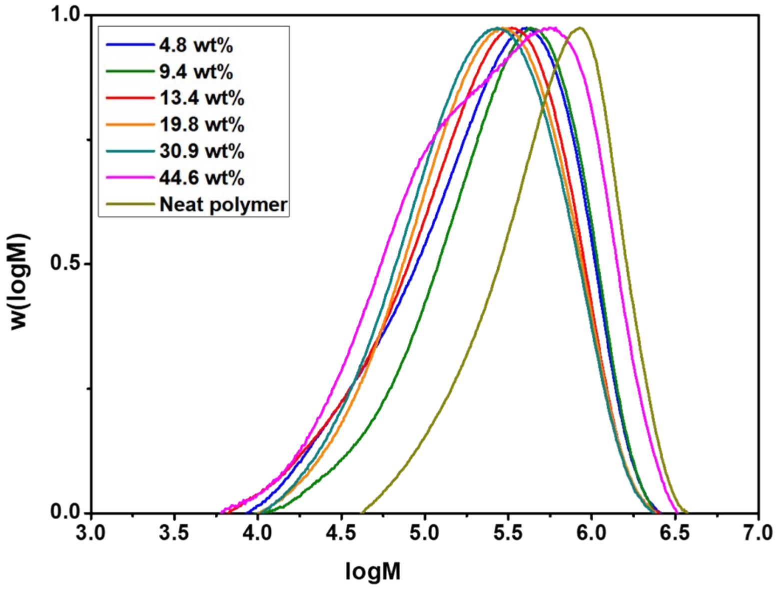

Figure S1. Molecular weight distributions of P(St-*stat*-*n*BA) and P(St-*stat*-*n*BA)/GO comprising different GO loadings synthesized via miniemulsion polymerization.

Table S1. Raman data showing the D and G peaks positions and the I_D/I_G ratios calculated from Lorentzian fitting of the deconvoluted D and G peaks obtained for polymer/rGO nanocomposite films.

System	GO conc.[a] in final film (%)	D Band (cm^{-1})	G Band (cm^{-1})	I_D/I_G
M1	4.8	1353	1589	0.76
M2	9.4	1353	1586	0.73
M3	13.4	1354	1587	0.76
M4	19.8	1354	1585	0.78
M5	30.9	1353	1585	0.77
M6	44.6	1354	1586	0.83
PM1	4.8	1353	1589	0.78
PM2	9.1	1353	1586	0.77
PM3	13.0	1354	1589	0.86
PM4	16.6	1355	1586	0.79
PM5	22.9	1355	1584	0.81
PM6	33.0	1355	1584	0.83

[a] wt% in final material (film) relative to total weight

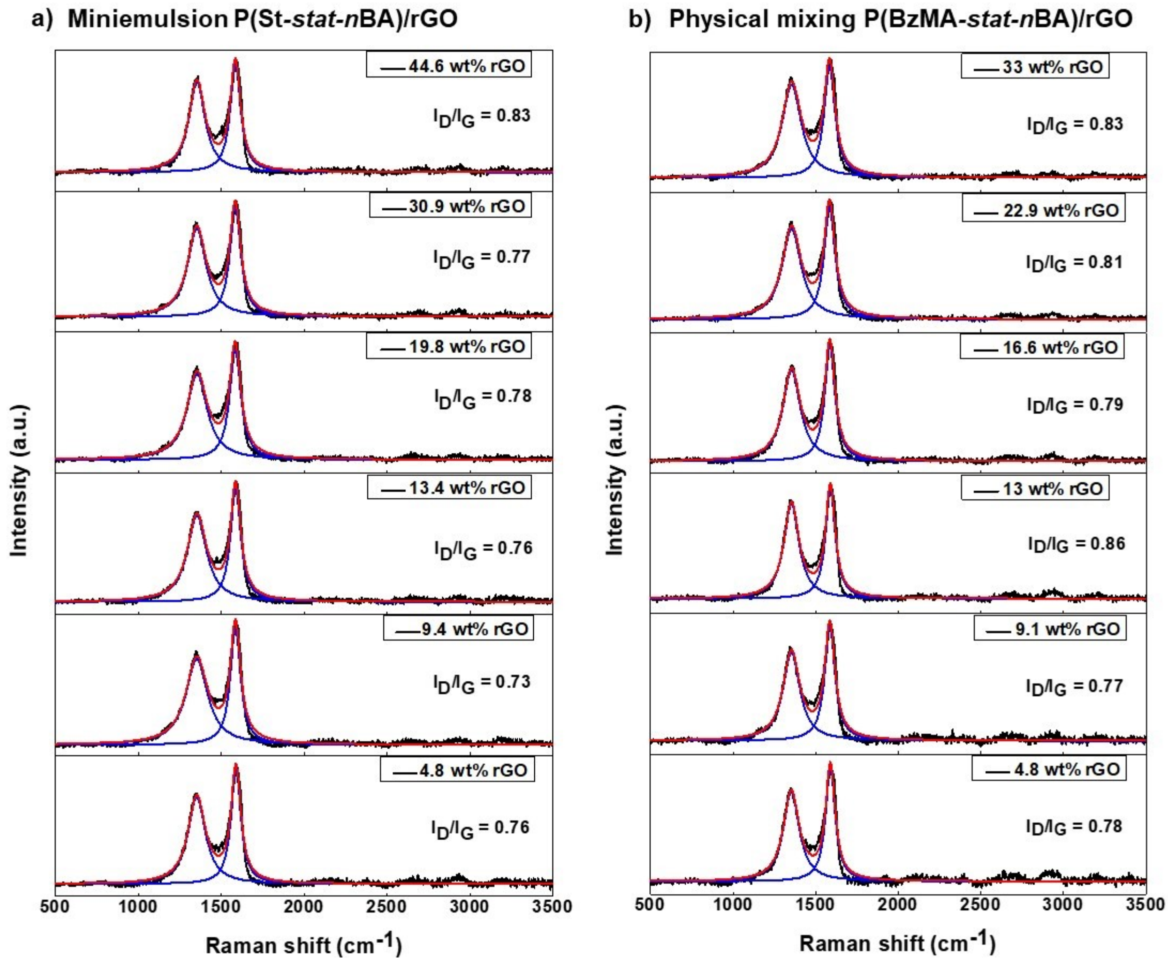

Figure S2. Raman spectra of polymer/rGO nanocomposite films with different concentrations of GO prepared via (a) miniemulsion and (b) physical mixing approaches.

Table S2. Electrical conductivity of polymer/rGO nanocomposite films containing 3% SDS with different concentrations of GO prepared via miniemulsion and physical mixing approaches.

System	GO conc. (wt%)	Conductivity (S/m)
M1	4.8	0.53 ± 0.18
M2	9.4	4.67 ± 0.07
M3	13.4	9.63 ± 0.08
M4	19.8	35.06 ± 12.62
M5	30.9	67.44 ± 10
M6	44.6	171.55 ± 36.12
PM1	4.8	3.24 ± 0.26
PM2	9.1	17.21 ± 1.96
PM3	13.0	24.12 ± 0.12
PM4	16.6	52.59 ± 5.73
PM5	22.9	86.82 ± 0.73
PM6	33.0	127.22 ± 11.76

Table S3. List of references used in Figure 2.

System	Graphene derivatives loading (wt%)	Electrical Conductivity (S m^{-1})	Reference
Emulsion	0.75	0.03	Spasevska et al. [1]
Emulsion	0.9	0.357	Yue et al.[2]
Emulsion	0.9	0.2	Arzac et al.[3]
Emulsion	1	3.4×10^{-4}	Hassan et al. [4]
Emulsion	1.4	0.09	Yan et al. [5]
Emulsion	2	0.029	Hu et al. [6]
Emulsion	3	1.5	Kuila et al. [7]
Emulsion	5	474	Imran et al. [8]
Emulsion	5	644	Imran et al. [9]
Emulsion	8	0.01	Wen-Ping et al. [10]
Emulsion	10	2.6	Zhang et al. [11]
Emulsion	13	0.867	Zheming et al. [12]
Miniemulsion	1	2×10^{-5}	Poddar et al. [13]
Miniemulsion	2	0.01	Nasirpouri et al. [14]
Miniemulsion	5	1.37	Fadil et al. [15]
Miniemulsion	5	0.8	Maslekar et al. [16]
Miniemulsion	20	222	Park et al. [17]
Physical mixing	0.9	0.236	Arzac et al. [3]
Physical mixing	1	10.9	Lai et al. [18]
Physical mixing	1	0.136	Spasevska et al. [19]
Physical mixing	2	0.1	Yousefi et al. [20]
Physical mixing	2	15	Tkalya et al. [21]
Physical mixing	2	12	Syurik et al. [22]
Physical mixing	4	0.1	Yousefi et al. [23]
Physical mixing	5	340	Fadil et al. [24]
Physical mixing	8	2.55	Li et al. [25]
Physical mixing	20	0.1	George et al. [26]
Physical mixing	25	1333	Wei et al. [27]
Melt mixing	0.2	5×10^{-3}	Kim et al. [28]
Melt mixing	2	1×10^{-9}	Kim et al. [29]

Melt mixing	3	1×10^{-8}	Zheng et al. [30]
Melt mixing	4	0.01	Zhao et al. [31]
Melt mixing	5	1×10^{-10}	Zheng et al. [30]
Melt mixing	5	5.2×10^{-6}	Beckert et al. [32]
Melt mixing	7.5	1×10^{-4}	Hofmann et al. [33]
Melt mixing	7.5	3×10^{-3}	Hofmann et al. [33]
Melt mixing	10	1	Zhao et al. [31]
Melt mixing	10	8.9×10^{-2}	Hofmann et al. [34]
Melt mixing	10	0.1	Pan et al. [35]
Melt mixing	12	0.12	Steurer et al. [36]
Melt mixing	15	0.05	Katbab et al. [37]
Melt mixing	28	1	Li et al. [38]
Solution mixing	0.2	1×10^{-3}	Wang et al. [39]
Solution mixing	1	1×10^{-3}	Zheng et al. [40]
Solution mixing	2	0.01	Ansari et al. [41]
Solution mixing	2	0.01	Nguyen et al. [42]
Solution mixing	4	1×10^{-5}	Hernández et al. [43]
Solution mixing	4	0.08	Ding et al. [44]
Solution mixing	5	1×10^{-3}	Ansari et al. [41]
Solution mixing	10	12	Goyal et al. [45]
Solution mixing	10	0.01	Zheng et al. [40]
Solution mixing	15	1	Ansari et al. [41]

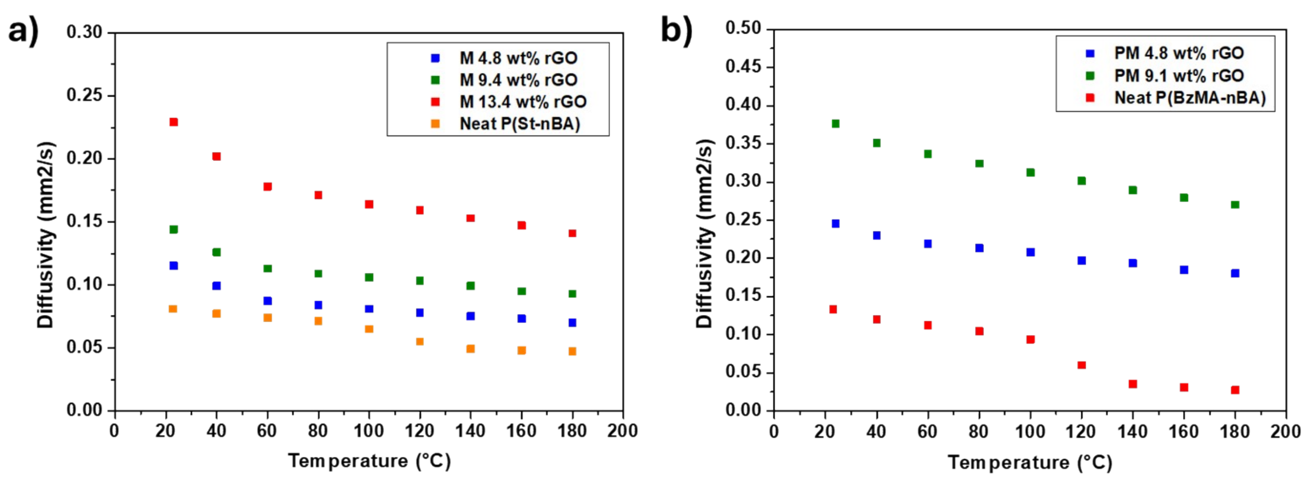

Figure S3. Thermal diffusivity data of the polymer/rGO nanocomposite films containing 3% SDS with different concentrations of GO prepared via (a) miniemulsion and (b) physical mixing approaches.

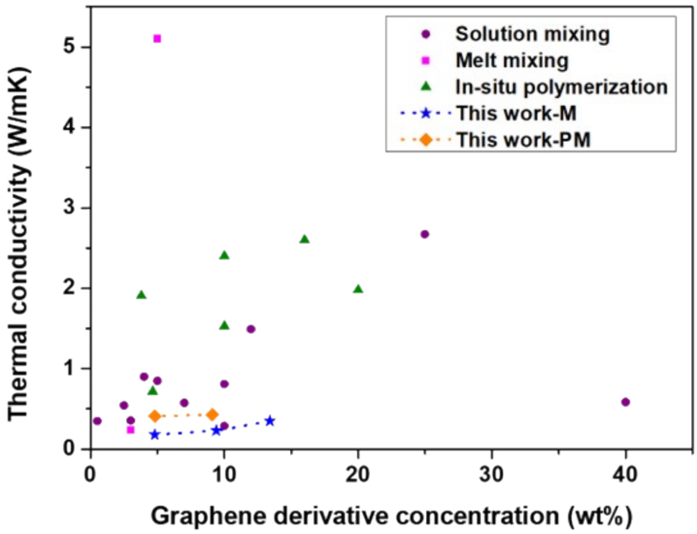

Figure S4. Comparison of thermal conductivities of this work with other studies (data for polymer/rGO composites prepared via different techniques - details of the references in SI Table SI4; graphene derivative wt% relative to total material). M stands for miniemulsion and PM stands for physical mixing.

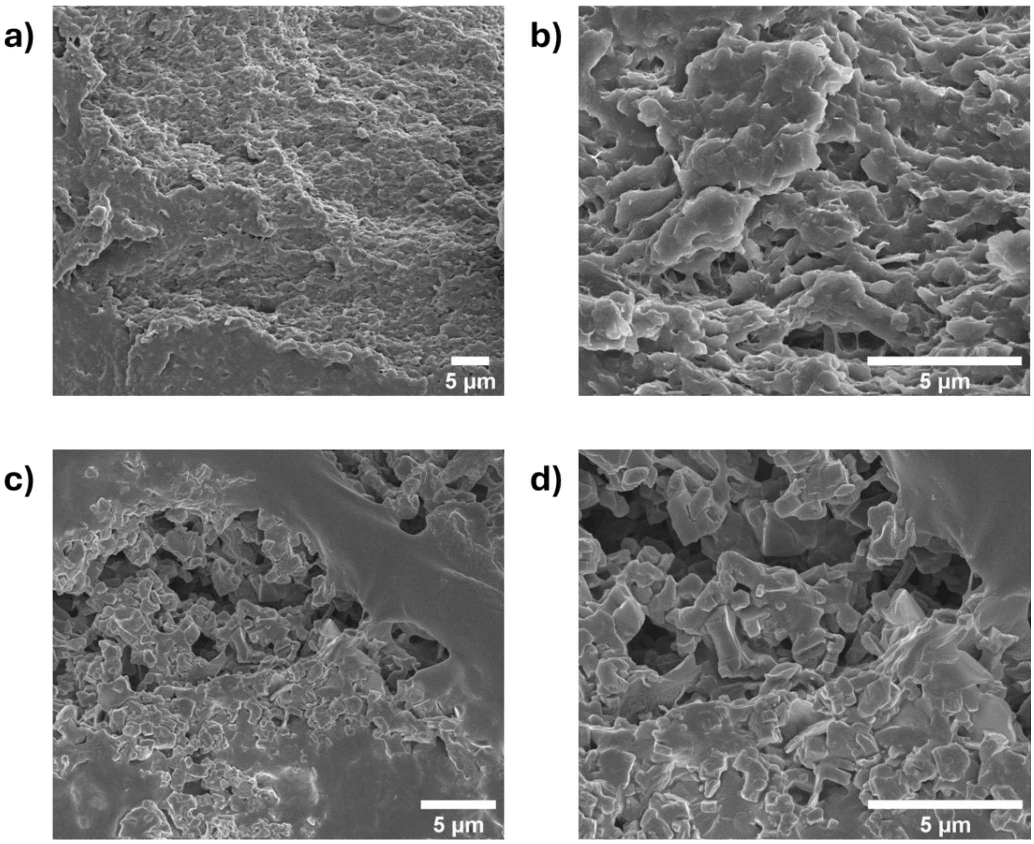

Figure S5. SEM images of (a and b) P(St-*stat*-*n*BA)/GO prepared via miniemulsion polymerization and (c and d) P(BzMA-*stat*-*n*BA)/GO prepared via physical mixing. All scale bars: 5µm

Table S4. List of references used in Figure 4.

System	Graphene derivatives loading (wt%)	Thermal Conductivity (W/mK)	Reference
Solution mixing	3	0.358	Kim et al. [46]
Solution mixing	5	0.85	Wang et al. [47]
Solution mixing	10	0.81	Tseng et al. [48]
Solution mixing	0.5	0.349	Zong et al. [49]
Solution mixing	4	0.9	Yavari et al. [50]
Solution mixing	10	0.29	Wu et al. [51]
Solution mixing	40	0.586	Qian et al. [52]
Solution mixing	12	1.49	Sun et al. [53]
Solution mixing	7	0.577	Dai et al. [54]
Solution mixing	25	2.67	Guo et al. [55]
Solution mixing	2.5	0.542	Tang et al. [56]
Melt mixing	3	0.24	Potts et al. [57]
Melt mixing	37.8	4.4	Gu et al. [58]
Melt mixing	5	5.1	Cho et al. [59]
In-situ polymerization	3.8	1.91	Teng et al. [60]
In-situ polymerization	10	1.53	Song et al. [61]
In-situ polymerization	4.64	0.72	Wan et al. [62]
In-situ polymerization	20	1.98	Kim et al. [63]
In-situ polymerization	10	2.4	Chen et al. [64]
In-situ polymerization	16	2.6	Varenik et al. [65]

Table S5. Mechanical properties of polymer/GO nanocomposite films at different GO loadings prepared via miniemulsion and physical mixing approaches. Data are presented as an average ± SD of three independent films.

System		GO conc. (wt%)	Young's modulus (MPa)	Tensile strength (MPa)	Elongation at break (%)
M	**M0**	-	1.3 ± 0.1	0.77 ± 0.2	845.7 ± 79.8
	M1	4.8	59.5 ± 7.3	4.3 ± 1.0	322.4 ± 39.4
	M2	9.4	157 ± 29.1	9.7 ± 0.4	28.2 ± 2.7
	M3	13.4	25.5 ± 2.7	2.8 ± 0.3	52.2 ± 2.6
PM	**PM0**	-	0.6 ± 0.2	2.0 ± 0.6	1054.9 ± 149.3
	PM1	4.8	21.6 ± 9.7	2.6 ± 0.2	79.3 ± 3.8
	PM2	9.1	159.1 ± 9.7	9.9 ± 0.7	15.4 ± 2.9
	PM3	13	248.0 ± 32.9	12.7 ± 1.1	16.1 ± 1.9
	PM4	16.6	246.4 ± 67.1	14.5 ± 1.4	10.8 ± 1.3
	PM5	22.9	283.8 ± 42.7	10.2 ± 1.1	8.2 ± 2.6
	PM6	33	215.1 ± 78.	5.2 ± 3.3	5.1 ± 1.8

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