Modified Graphene/Polyimide Nanocomposites: Reinforcing and Tribological Effects

Ting Huang[a], Yuanshi Xin[a], Tongsheng Li[a]*, Steven Nutt[b], Chao Su[a], Haiming Chen[a], Pei Liu[a] and Zuliang Lai[a]

[a]State Key Laboratory of Molecular Engineering of Polymers, Department of Macromolecular Science, Fudan University, Shanghai, 200433, P. R. China and [b]Department of Chemical Engineering and Materials Science, University of Southern California, Los Angeles, CA, 90089-0241, United States

Supporting Information

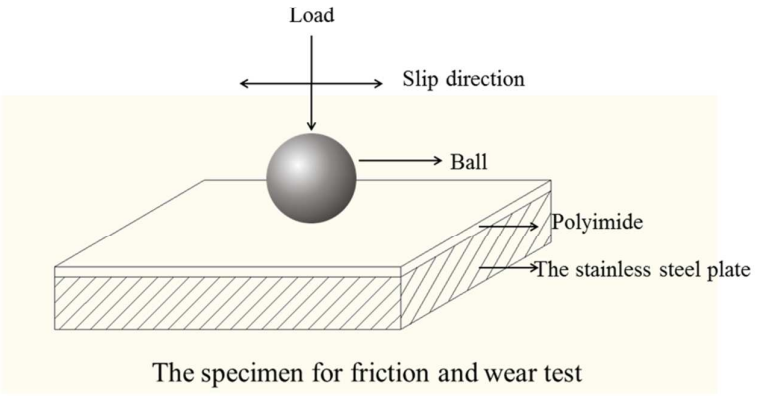

Figure S1. Schematic diagram of the contact configuration of the reciprocating friction and wear testing machine.

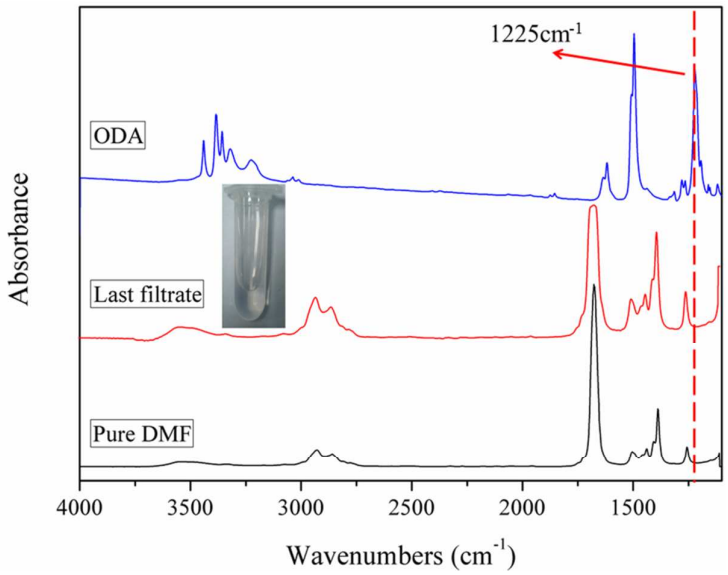

Figure S2. FTIR spectra of ODA, last filtrate and pure DMF, as well as typical photograph of the last filtrate (inset), respectively.

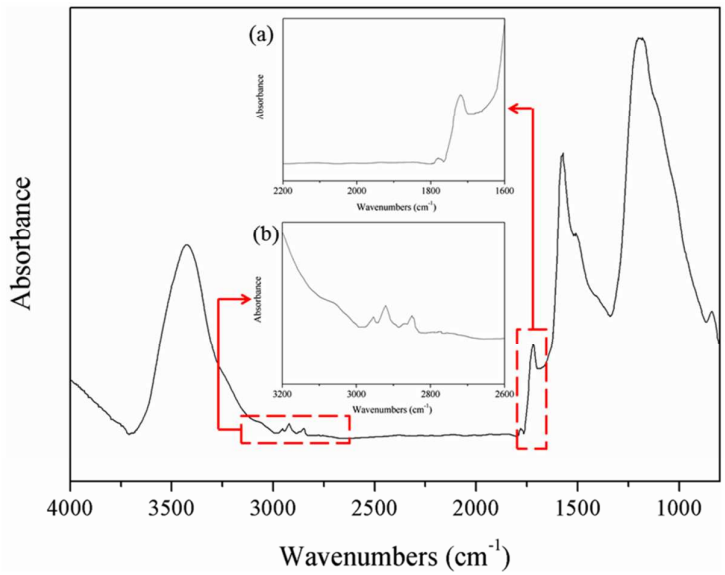

Figure S3. FTIR spectra of MG-BPADA after thermal imidization.

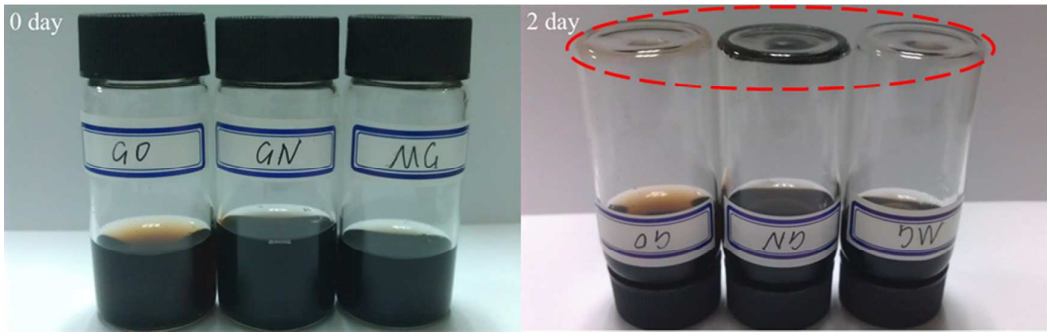

Figure S4. The dispersibility and time-dependent stability of GO, GN and MG in DMF solvent.

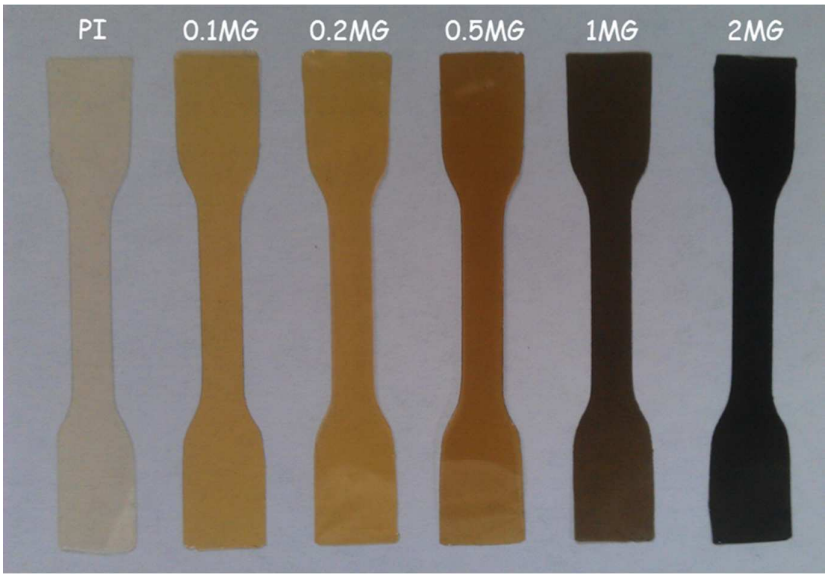

Figure S5. Appearance for dog-bone type specimens of neat PI and MG/PI nanocomposite films

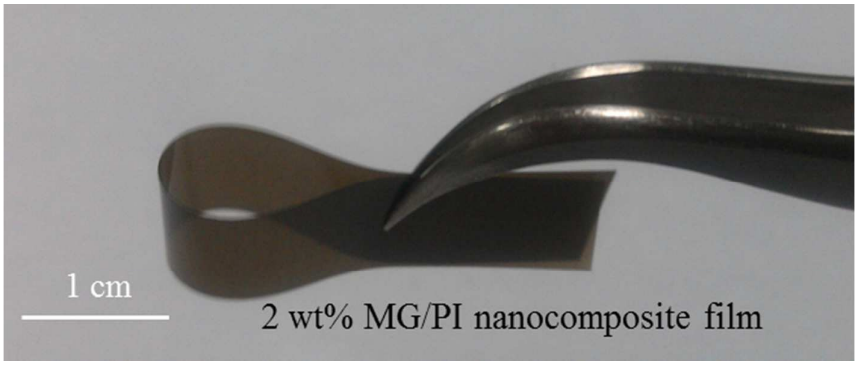

Figure S6. A typical figure shows high flexibility of 2 wt% MG/PI nanocomposite film.

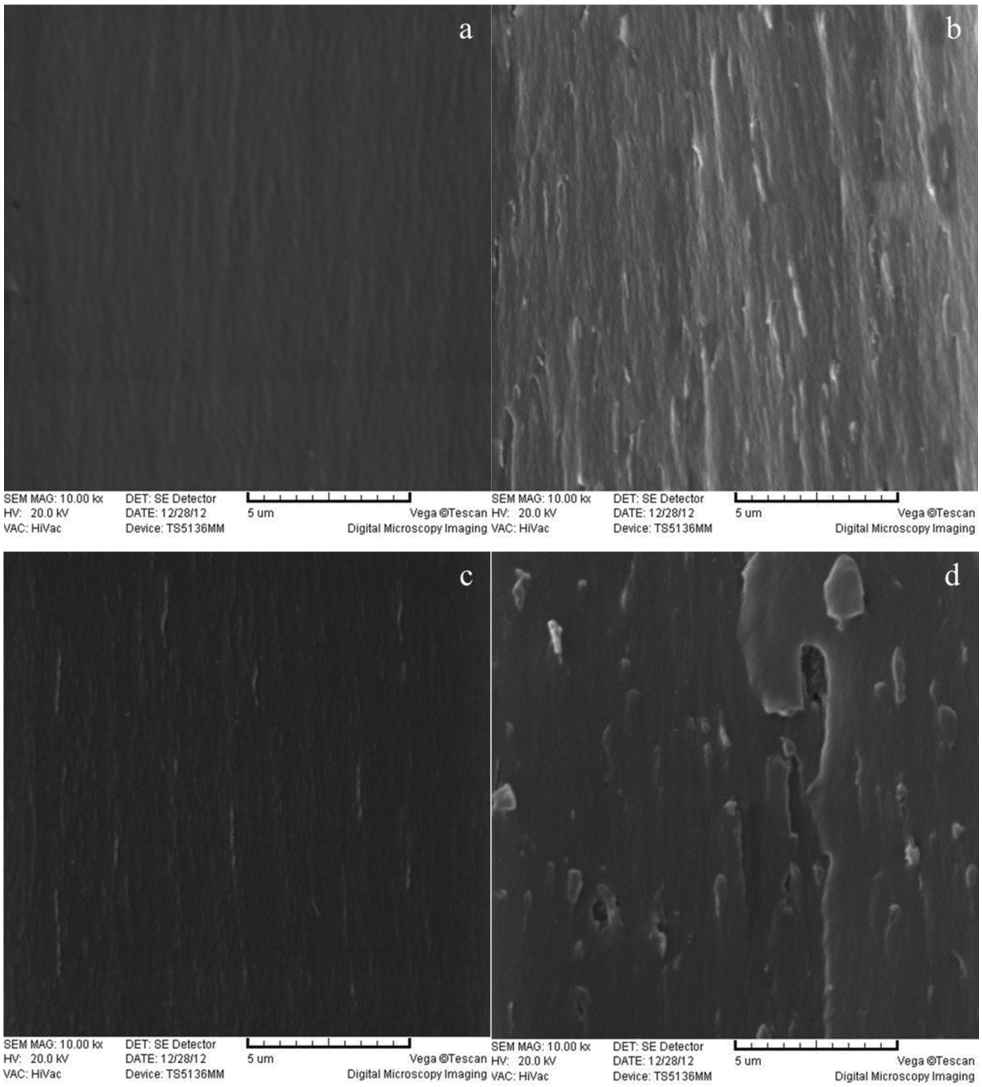

Figure S7. SEM images of fracture surfaces of (a) neat PI, (b) 2 wt% MG/PI, (c) 1 wt% MG/PI and (d) 1 wt% GN/PI specimens (magnification: 1000).

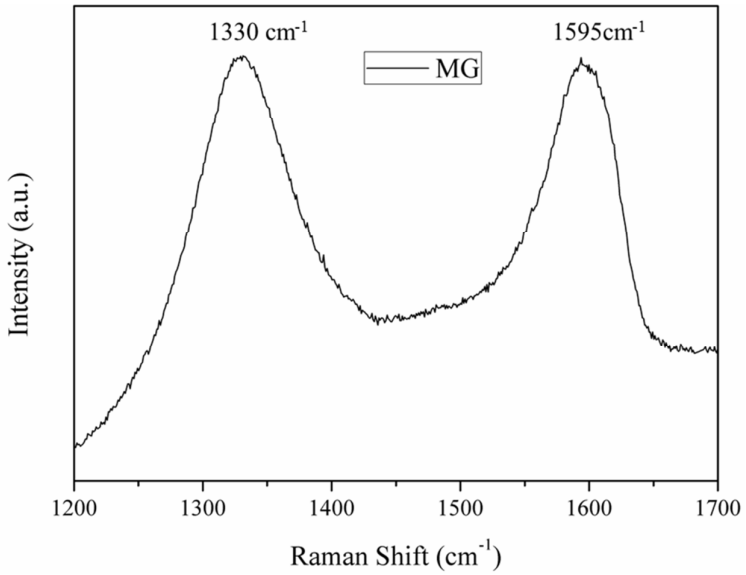

Figure S8. Raman spectrum of MG.

Table S1. Data based on properties of all the MG/PI specimens

Specimens	0.1 wt% MG/PI	0.2 wt% MG/PI	0.5 wt% MG/PI	1 wt% MG/PI	2 wt% MG/PI
Tensile strength (MPa)	92	97	107	115	120
Young's modulus (GPa)	1.72	1.78	1.92	2.14	2.32
Elongation at break (%)	21.56	19.79	16.90	16.67	15.67
T_g (^oC)	225	229	232	237	240
Microhardness (MPa)	397	478	532	586	607
T_5[a] (^oC)	548	553	564	567	569
Electrical conductivity (Sm^{-1})	8.6×10^{-10}	3.6×10^{-7}	3.1×10^{-4}	2.6×10^{-3}	8.9×10^{-3}
Friction coefficient	0.398	0.389	0.377	0.365	0.360
Wear rate (mm^3/Nm)	8.42×10^{-5}	6.98×10^{-5}	3.89×10^{-5}	1.54×10^{-5}	0.66×10^{-5}

[a]T_5: the temperature at 5 wt% of weight loss was recorded by TGA with a heating of 20 ^oC/min under N_2 atmosphere.