Supporting Information

Using POSS-C_{60} Giant Molecules as a Novel Compatibilizer for PS/PMMA Polymer Blends

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Experimental Section

Materials. Polystyrene (PS, PG33) was purchased from Sino-foreign Joint Venture Zhenjiang Qimei Chemical Co., Ltd.Polymethyl methacrylate (PMMA, SUMIPEX MH) was purchased from Sumitomo Chemical Corporation (Singapore).Aminopropylisobutyl-POSS (AM0265) were purchased from Hybird Plastics, [60]fullerene were purchased from Yurui (Shanghai) chemical Co., Ltd. Ethyl hydrogen malonate (98%), 4-(dimethylamino)-pyridine (99%), 1,8-diazabicyclo[5.4.0]undec-7-ene (98%), iodine (98%) were purchased from J&K Chemicals. Tetrahydrofuran (THF), dichloromethane (DCM), toluene, xylene, petroleum ether (PE) and ethyl acetate (EA) were purchased from Chengdu Kelong Chemical Co., Ltd. Toluene was dried over CaH_2 and distilled prior to use.

Sample Preparation. A detailed account of the synthesis of Janus POSS-C_{60} (JPC) nanoparticles has been published elsewhere.[1] PS/PMMA (which means physical blends of PS and PMMA) and PS/PMMA/JPC blends (which means physical blends of PS, PMMA and JPC) were

prepared according to the following general process. Firstly, PS/PMMA (mass ratio 70/30, the total masses of PS and PMMA was 10 g) were dissolved in tetrahydrofuran (THF, 100 mL) and the appropriate amounts of JPC was dissolved in THF (20 mL) at room temperature. Secondly, the PS/PMMA solution and the JPC solution were mixed together and stirred overnight. Thirdly, the solution mixture was precipitated into a large amount of methanol. Lastly, the solution mixture were dried by evaporation to remove all the solvents and dried in vacuum at 60 °C for 2 days. It should be noted that the 5 wt% of PS/PMMA/POSS, PS/PMMA/C_{60} and PS/PMMA/POSS/C_{60} (POSS/C_{60} means the physical blends of POSS and C_{60}, and it takes 1:1 molar ratio of POSS and C_{60}) were mixed using xylenes as the solvent with the same concentration when using THF. The samples for mechanical measurements were processed by compression molding at 190 °C and a pressure of 10 MPa for 5 minutes.

Characterization.

Scanning Electron Microscopy (SEM). The morphology of fracture surface of the PS/PMMA and PS/PMMA/JPC samples were examined by (SEM) (Inspect F, FEI, USA) at 5 kV accelerating voltage.Theselective extraction the PMMA domains were used acetic acid for 2h.[2] The surface was sputter-coated with a gold layer before testing.

Transmission Electron Microscope (TEM). In order to further observe the precise feature of phase morphology of the samples, the samples were ultramicrotomed to form the sections around 80 nm thick at -120 °C using a cryo-ultramicrotome (Leica EM FC7, Germany) with a diamond knife, and stained with RuO_4 for 90 min.[3] The stained sections of the samples were observed under the transmission electron microscope (TEM) (JEOL JEM-2100F, Japan).

Scanning Electron Microscopy (SEM) and energy dispersive X-ray spectrometry (EDS). The fracture surface of PS/PMMA/JPC blends were used for EDS analysis the Si element at 20 kV accelerating voltage.(JSM-7500F/X-MAX50, Japan).

Tensile properties. The tensile specimens were cut from the compression-molded film with the thickness around 0.6 mm and the width around 5 mm, and then tested using the Instron 4302 universal tensile testing machine at room temperature. The distance of two grips was 15 mm and the crosshead speed was 50 mm min^{-1}. All the specimens were tested at least 4 times.

Table S1. Surface tensions of POSS, C_{60}, PS and PMMA.

Materials	Surface tensions (mN/m)		
	Total (γ)	Dispersive part (γ^d)	Polar part (γ^p)
POSS[4]	42.2	38.1	4.1
C_{60}[5]	46.2	44.1	1.8
PS[6]	43.3	39.6	3.8
PMMA[6]	44.9	36.1	8.8

It should be noted that the surface tension of POSS in this calculation is instead with polypropylene (PP) because all of the isobutyl groups on POSS have similar chemical structure with PP.

Table S2. Calculated interfacial tensions of PS/C_{60}, PMMA/POSS and PS/PMMA

Interfacial tension (mN/m)		
$\gamma_{C60/PS}$	$\gamma_{POSS/PMMA}$	$\gamma_{PS/PMMA}$
1.16	1.77	2.05

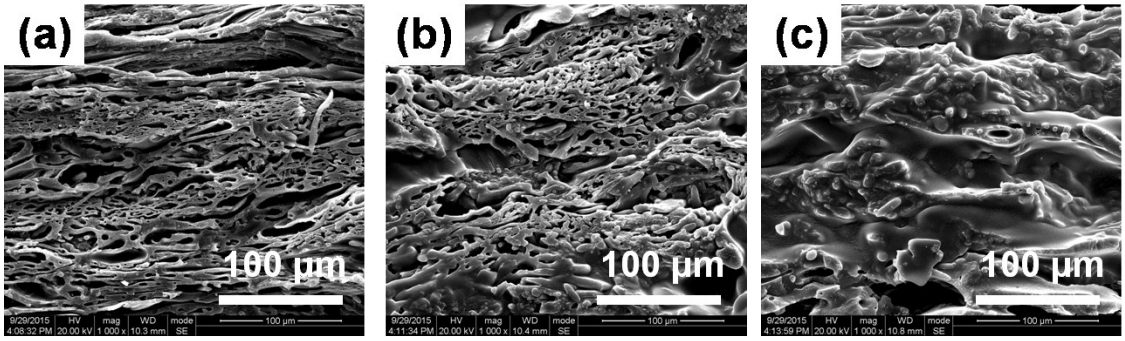

Figure S1. SEM micrographys of PS/PMMA(mass ratio: 30/70) blends with various nanoparticles loading. (a) neat PS/PMMA, (b) adding 1 wt% JPC, (c) adding 5 wt% JPC. THF was used as the solvent for solution blend.

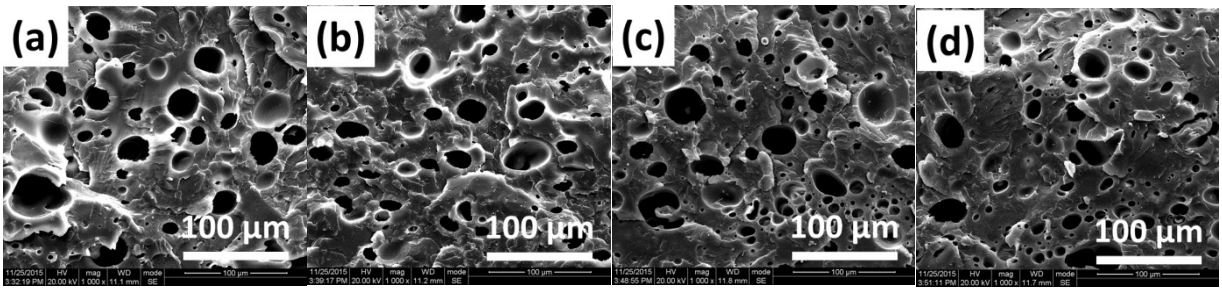

Figure S2. SEM micrographys of PS/PMMA(mass ratio: 70/30) blends with various nanoparticles loading. (a) neat PS/PMMA, (b) adding 5 wt% POSS, (c) adding 5 wt% POSS/C_{60}, (d) adding 5 wt% C_{60}. Xylenes was used as the solvent for solution blend.

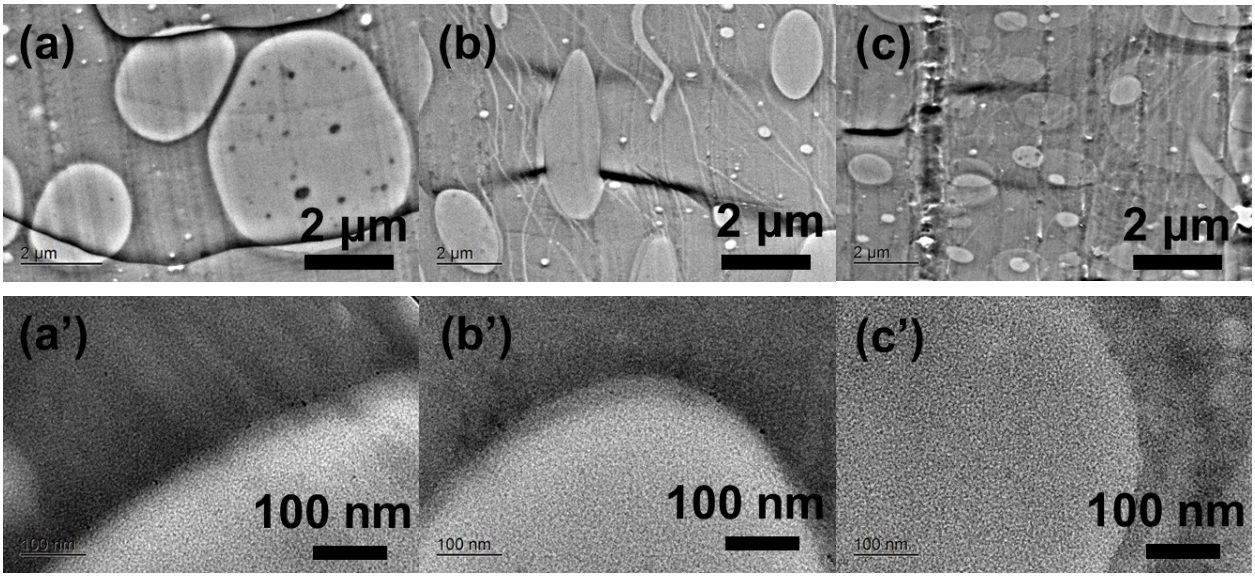

Figure S3TEM images by adding (a) (a') 0wt%,(b) (b') 1wt% and (c) (c') 5wt% of JPC in the PS/PMMA (mass ratio: 70/30)blends. (a')(b')(c') represent the PS/PMMA phase of (a)(b)(c). The light grey represents dispersed PMMA phase and the dark grey represents PS matrix.

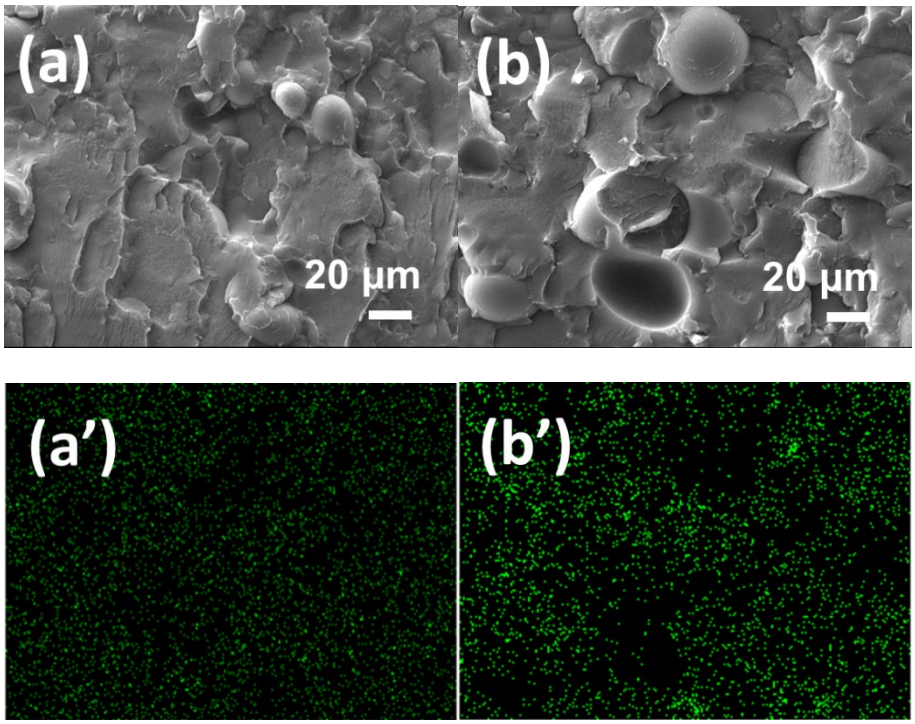

Figure S4.SEM-EDS images of the Si element disperse on the cryo-fracture surface of PS/PMMA blends, the green dots in (a') and (b') represent Si element of POSS. (a) and (a') 5 wt% of POSS/C_{60}, (b) and (b') 5 wt% of POSS.

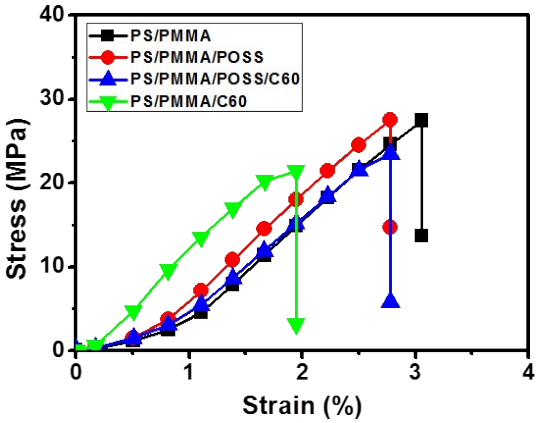

Figure S5. Typical strain-stress curves of PS/PMMA(mass ratio: 70/30) blends by adding 5 wt% of POSS, POSS/C_{60} and C_{60}.

References

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