Supporting Information

Enhancing Impact Resistance of Polymer Blends via Self-Assembled Nanoscale Interfacial Structures

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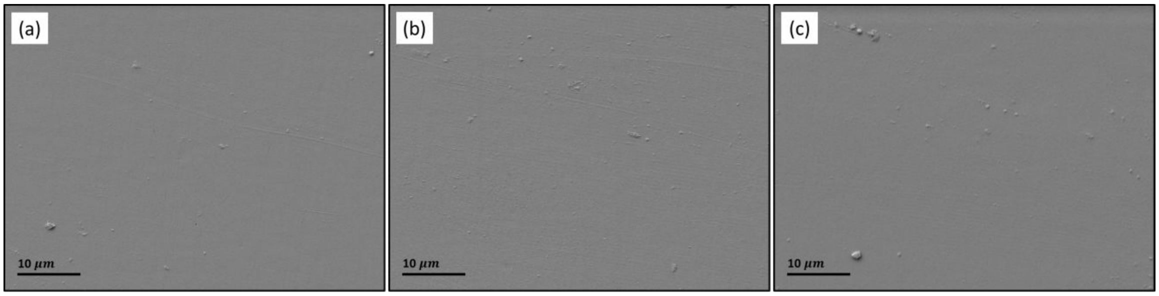

Figure S1. SEM images of cryo-sliced cross sectional surfaces: (a) 97PLA3PMMA, (b) 88PLA12PMMA, (c) 70PLA30PMMA.

Figures S1a to S1c show the scanning electron microscopy (SEM) images taken on the cryo-sliced cross sectional surface of the binary blends. From those images, we can see that the blend surfaces have no sign of phase separation, confirming the complete miscibility of PLA and PMMA when mixing them via melt blending.

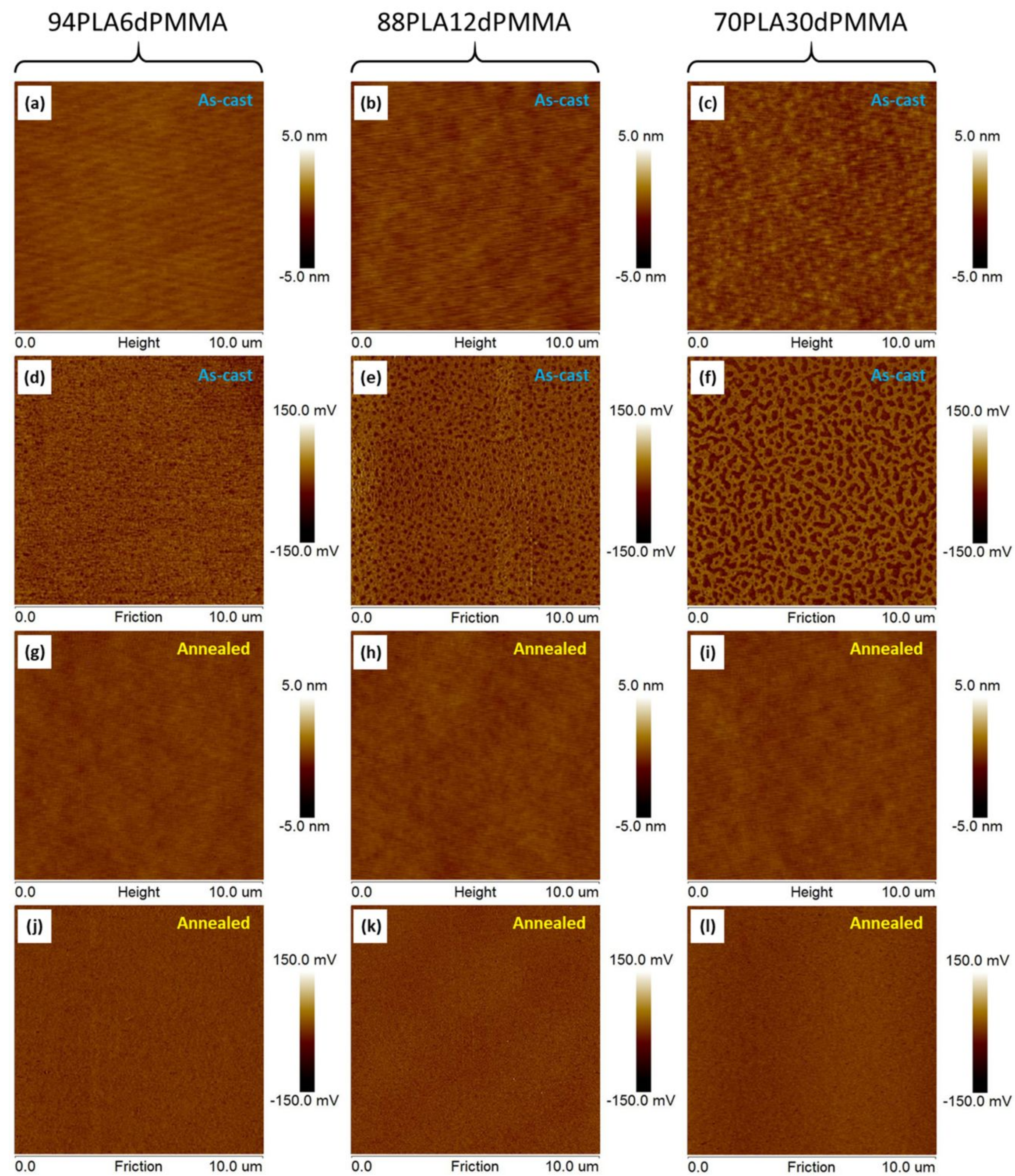

Figure S2. AFM images of as-cast PLA/dPMMA blend films: height images of (a) 94PLA6dPMMA film, (b) 88PLA12dPMMA film, (c) 70PLA30dPMMA film, and friction images of (d) 94PLA6dPMMA film, (e) 88PLA12dPMMA film, (f) 70PLA30dPMMA film. AFM images of annealed PLA/dPMMA blend films: height images of (g) 94PLA6dPMMA film, (h) 88PLA12dPMMA film, (i) 70PLA30dPMMA film, and friction images of (j) 94PLA6dPMMA film, (k) 88PLA12dPMMA film, (l) 70PLA30dPMMA film. The annealing was conducted at 180 ℃ for 30 min.

In Figure S2, we find that the height image of 94PLA6dPMMA film shows no sign of phase separation, while the corresponding friction image shows numerous small isolated domains with higher surface hardness, which can be identified as the dPMMA phase. The films with higher dPMMA content display higher surface roughness in height images (Figure S2b and S2c) and more obvious phase separation in friction images (Figure S2e and S2f). Those AFM images are consistent with the observations in the above mentioned studies that in solvent-casting, the different solubility of PLA and PMMA with chloroform can result in the phase separation of the blend. In order to eliminate the phase separation, the thin films were annealed in a vacuum oven at 180 ℃ for 30 min. After annealing, all the blend films show the flat and homogeneous surfaces (roughness, Rq, is less than 0.5 nm) in both height and friction AFM images (Figure S2g-S2l), which indicates that thermal annealing is able to drive the phase fusion of the phase separated PLA/dPMMA blend thin film.

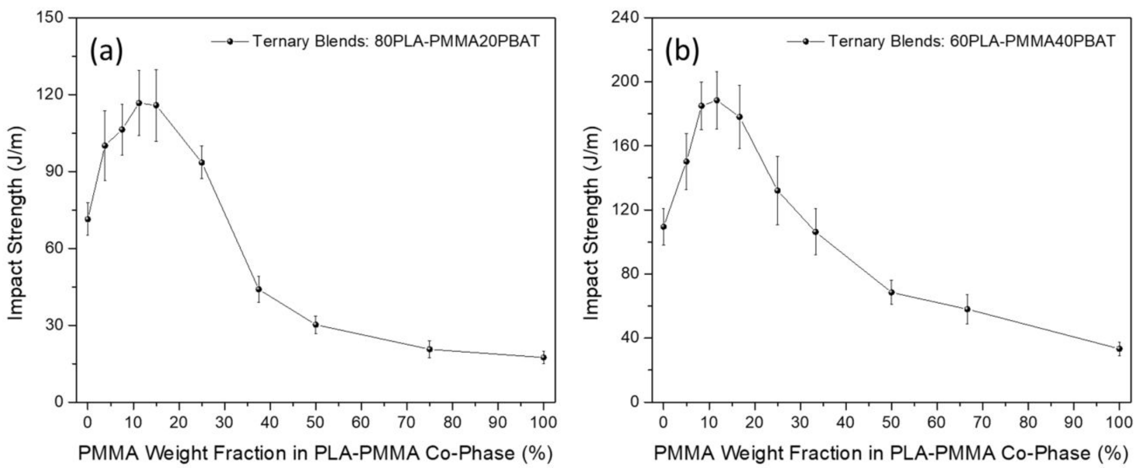

Figure S3. Impact strength of PLA/PMMA/PBAT blends vs. PMMA weight fraction in PLA-PMMA co-phase. (a) 20 wt% of PBAT, (b) 40 wt% of PBAT.

Figure S3a and S3b show the impact strength vs. PMMA weight fraction profiles of ternary blends with 20 wt% and 40 wt% of PBAT, where we find that both profiles increase at low PMMA weight fraction. Like the situation in the case of 30 wt% of PBAT, both profiles show the maximum values when the PMMA weight fractions in the PLA-PMMA co-phase are around 11 to 12%. After this, both cases show dramatically drop. In the case of the blends with 20 wt% of PBAT, the 71PLA9PMMA20PBAT sample has the highest impact strength ~117 J/m, while for the blends with 40 wt% PBAT, the 53PLA7PMMA40PBAT sample shows the best value ~188 J/m.