Electronic Supplementary Material (ESI) for RSC Advances.

Support information

Upcycling of Semicrystalline Polymers by Compatibilization: Mechanism and Location of Compatibilizers

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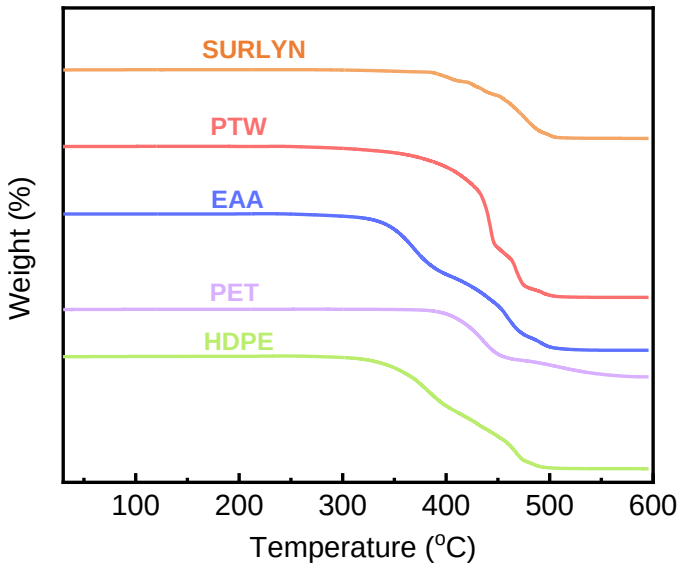

Figure S1 TGA of individual components used in this work (PET, HDPE, EAA, PTW and Surlyn) to show the stability of the samples during the processing. The TGA profiles were vertically shifted for clarity. The processing temperature for twin-screw extrusion was 255 °C and the compression molding temperature was 270 °C, both below the degradation temperatures of all the components.

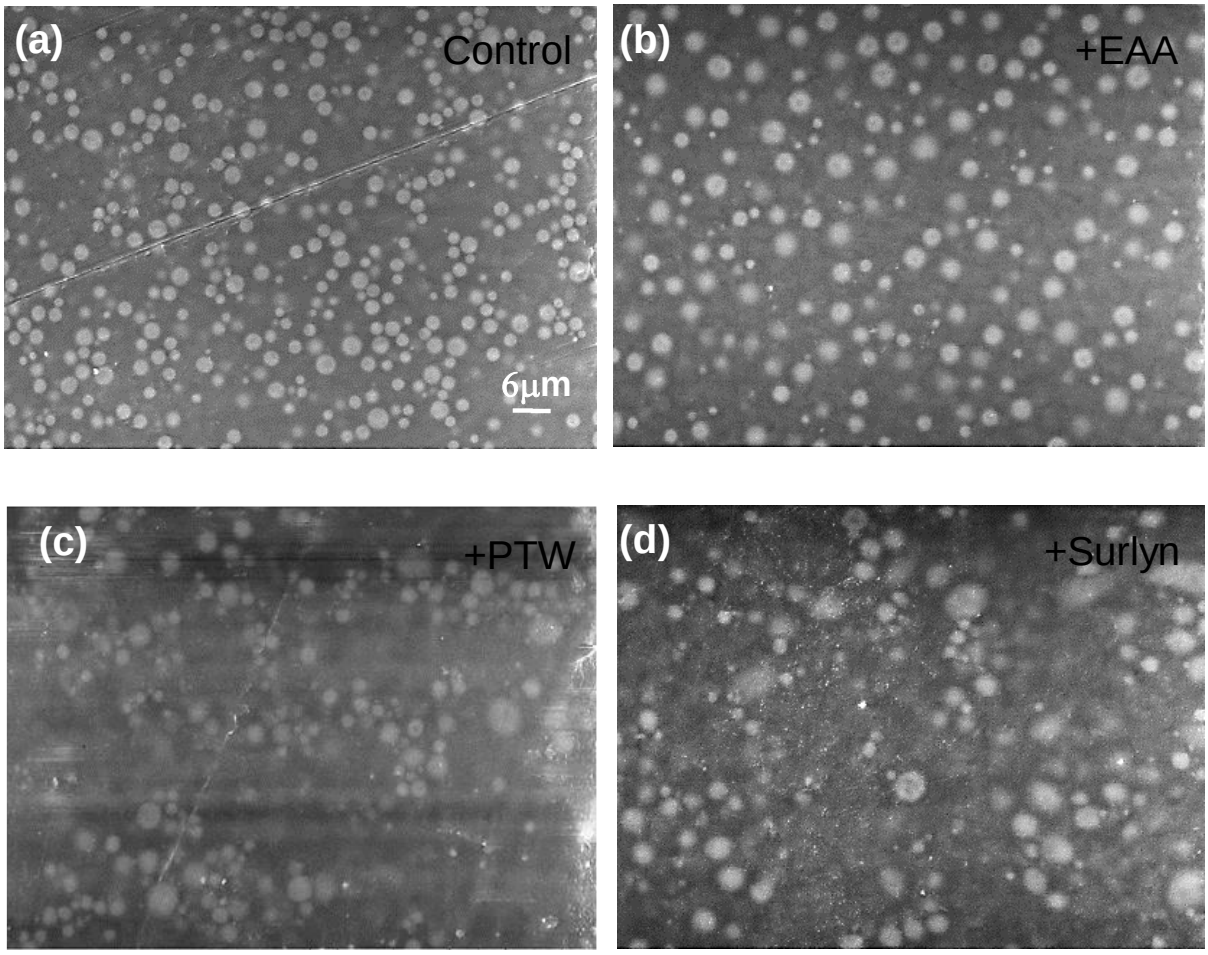

Figure S2 Morphology of PET/PE blends. (a-d), SEM images of control (a), +EAA (b), +PTW (c) and + Surlyn (d). The scale bar in (a) applies to (b), (c) and (d).

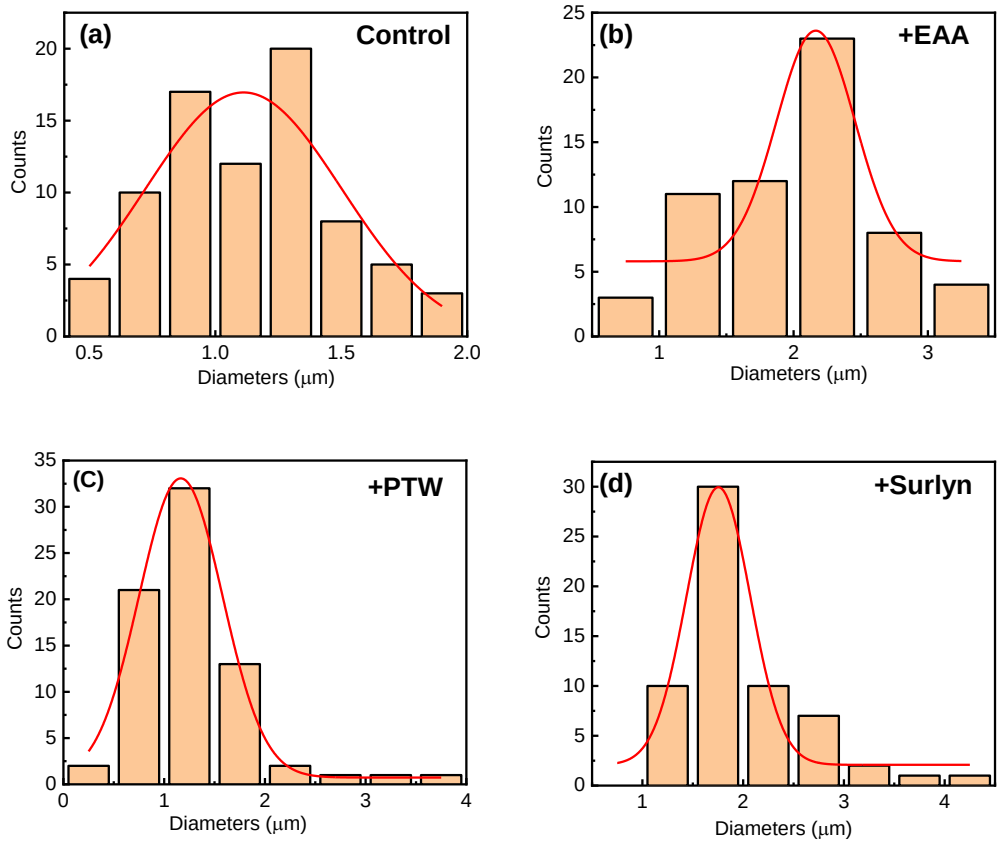

Figure S3 Droplet size analysis from AFM for control (a), +EAA (b), +PTW (c) and + Surlyn (d). The cross-sectional area of individual PET droplets was measured with imageJ. The diameters were then calculated using the equation of $A_{area} = 2p(D/2)^2$. The size distributions of which were fitted with a Gaussian function to get a mean diameter and standard deviation for each sample.

Table S1. Droplet size of control, +EAA, +PTW and + Surlyn.

Sample Code	*D* [mm]
Control	1.11 ± 0.85
+EAA	2.17 ± 1.58
+PTW	1.16 ± 1.77
+Surlyn	1.75 ± 1.77

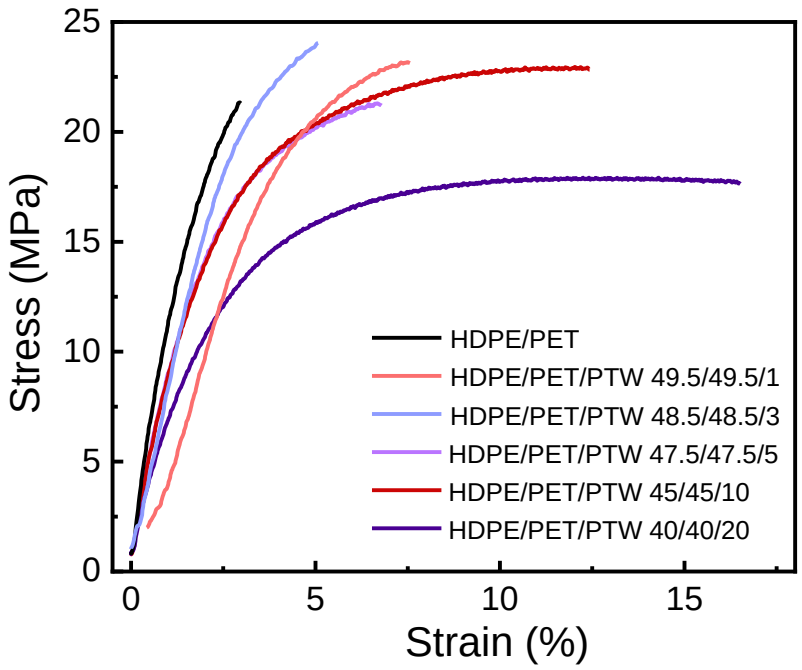

Figure S4 Mechanical properties for HDPE/PET/PTW with different PTW concentrations: representative stress–strain curves of the ternary blends with PTW concentrations of 1%, 3%, 5%, 10% and 25%. as well as HDPE/PET control blend.

Table S2 Mechanical properties for HDPE/PET/PTW with different PTW concentrations and its specific modulus, strain, and stress based on the composition ratio.

Sample	Mechanical Properties (obtained from the test)		
	Elastic Modulus (Mpa)	Tensile Strength at Break (MPa)	Elongation at Break (%)
HDPE/PET	11.90 ± 1.10	21.03 ± 0. 0.31	3.06 ± 0.11
HDPE/PET/PTW 49.5/49.5/1	2.65 ± 0.43	22.49 ± 1.87	6.52 ± 1.38
HDPE/PET/PTW 48.5/48.5/3	5.35 ± 2.93	25.07 ± 0.85	6.69 ± 1.79
HDPE/PET/PTW 47.5/47.5/5	8.26 ± 0.16	26.66 ± 4.02	7.47 ± 2.51
HDPE/PET/PTW 45/45/510	9.13 ± 0.51	22.55 ± 0.40	13.58 ± 1.21
HDPE/PET/PTW 40/40/20	6.35 ± 0.043	17.89 ± 0.71	19.48 ± 2.94
PTW	0.087	4.99	1257.90

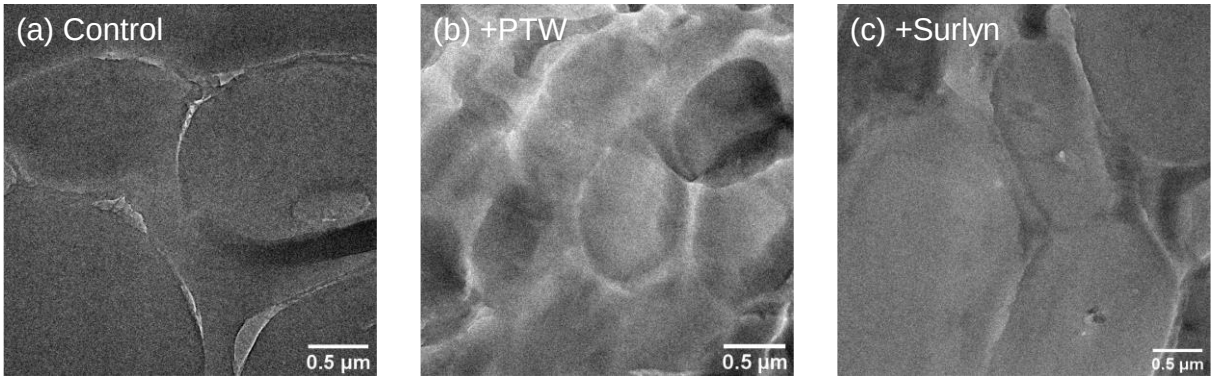

Figure S5 Zoomed out TEM images of (a) Control, (b) +PTW and (c) +Surlyn.

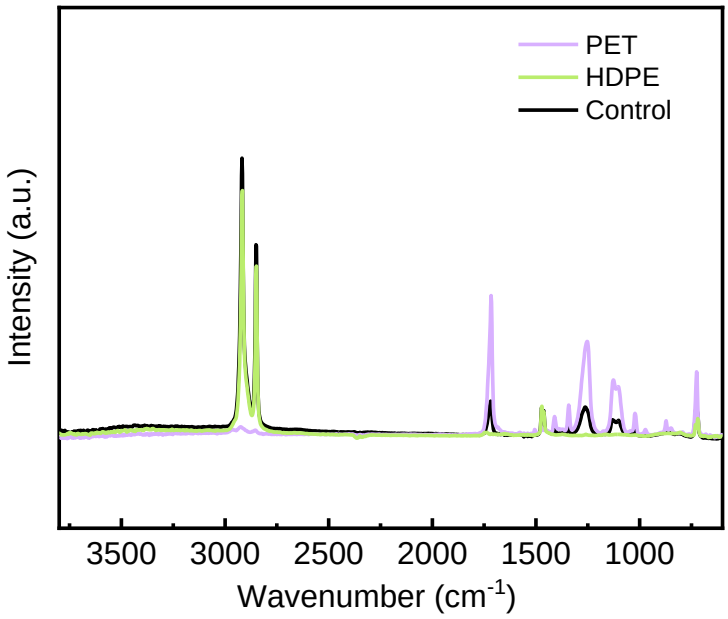

Figure S6 FTIR spectra of pure PET, pure PE polymers and control sample (PET/PE blend).

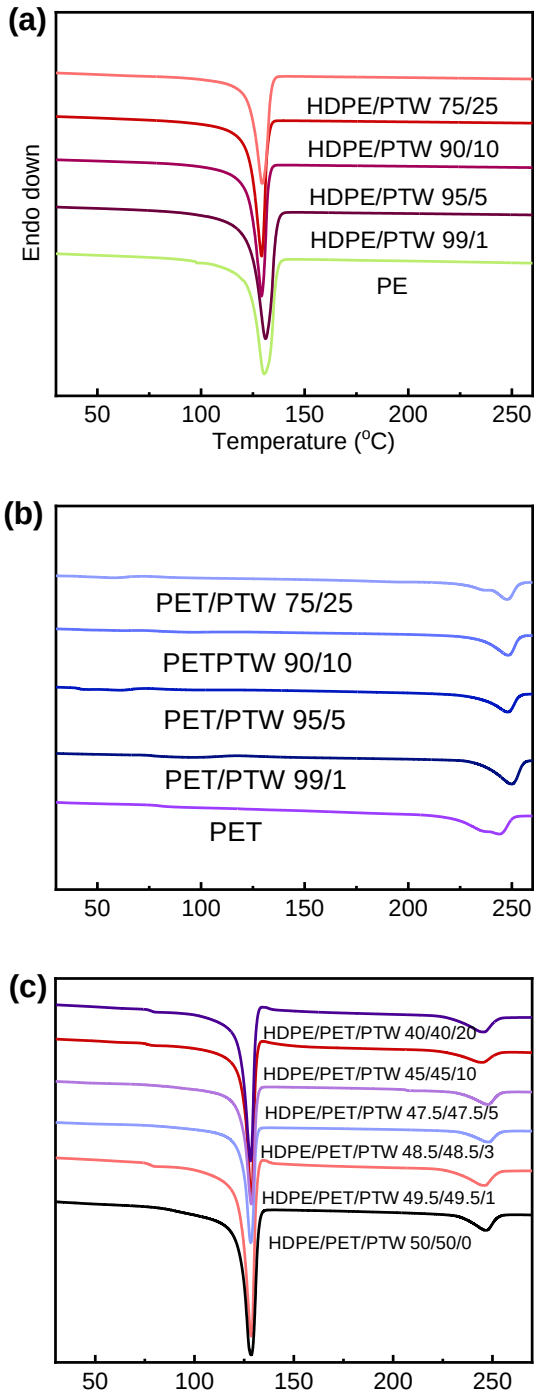

Figure S7 The DSC thermograms of a series of binary and ternary blends containing PTW. (a), the heating scan of the DSC measurements for HDPE/PTW with PTW concentration of 1%, 5%, 10% and 25%; (b), the heating scan of the DSC for PET/PTW with PTW concentration of 1%, 5%, 10% and 25%; (c), the heating scan of the DSC for ternary blend HDPE/PET/PTW with the concentration of PTW of 1%, 3%, 5%, 10% and 25%.

Table S3 The key thermal parameters for HDPE/PTW with PTW concentration of 1%, 5%, 10% and 25% obtained from the DSC measurements.

Sample Code	$T_{m,\ HDPE}$ [°C]	$X_{c,\ HDPE}$ [%]
PE	130.0 ± 0.5	66.6 ± 2.2
HDPE/PTW 99/1	129.3 ± 0.4	66.1 ± 2.1
HDPE/PTW 95/5	129.5 ± 0.3	57.4 ± 1.7
HDPE/PTW 99/10	129.5 ± 0.8	60.0 ± 0.6
HDPE/PTW 75/25	129.3 ± 0.4	67.4 ± 0.2

Table S4 The key thermal parameters for PET/PTW with PTW concentration of 1%, 5%, 10% and 25% obtained from the DSC measurements.

Sample Code	$T_{m,\ PET}$ [°C]	$X_{c,\ PET}$ [%]
PE	246.6 ± 0.5	28.2 ± 1.1
PET/PTW 99/1	249.6 ± 0.3	30.6 ± 1.9
PET/PTW 95/5	248.1 ± 0.1	30.5 ± 1.9
PET/PTW 99/10	248.5 ± 0.3	31.0 ± 1.7
PET/PTW 75/25	248.3 ± 0.4	29.7 ± 2.1

Table S5 The key thermal parameters for HDPE/PET/PTW with the concentration of PTW of 1%, 3%, 5%, 10% and 25% obtained from the DSC measurements.

Sample Code	$T_{m,\ HDPE}$ [°C)]	$T_{m,\ PET}$ [°C]	$X_{c,\ HDPE}$ [%]	$X_{c\ ,PET}$ [%]
HDPE/PET 50/50	128.3 ± 0.4	245.8 ± 0.9	75.4 ± 5.9	24.4 ± 1.4
HDPE/PET/PTW 49.5/49.5/1	128.5 ± 0.2	248.1 ± 0.2	66.2 ± 2.7	25.7 ± 0.3
HDPE/PET/PTW 48.5/48.5/3	128.3 ± 0.3	247.8 ± 0.1	61.9 ± 1.3	26.3 ± 0.6
HDPE/PET/PTW 47.5/47.5/5	128.0 ± 0.2	245.5 ± 0.1	60.2 ± 4.1	27.2 ± 1.5
HDPE/PET/PTW 45/45/10	127.9 ± 0.1	245.6 ± 0.5	70.5 ± 5.5	25.6 ± 1.9
HDPE/PET/PTW 40/40/20	127.6 ± 0.2	246.4 ± 0.4	72.8 ± 2.4	25.9 ± 2.7

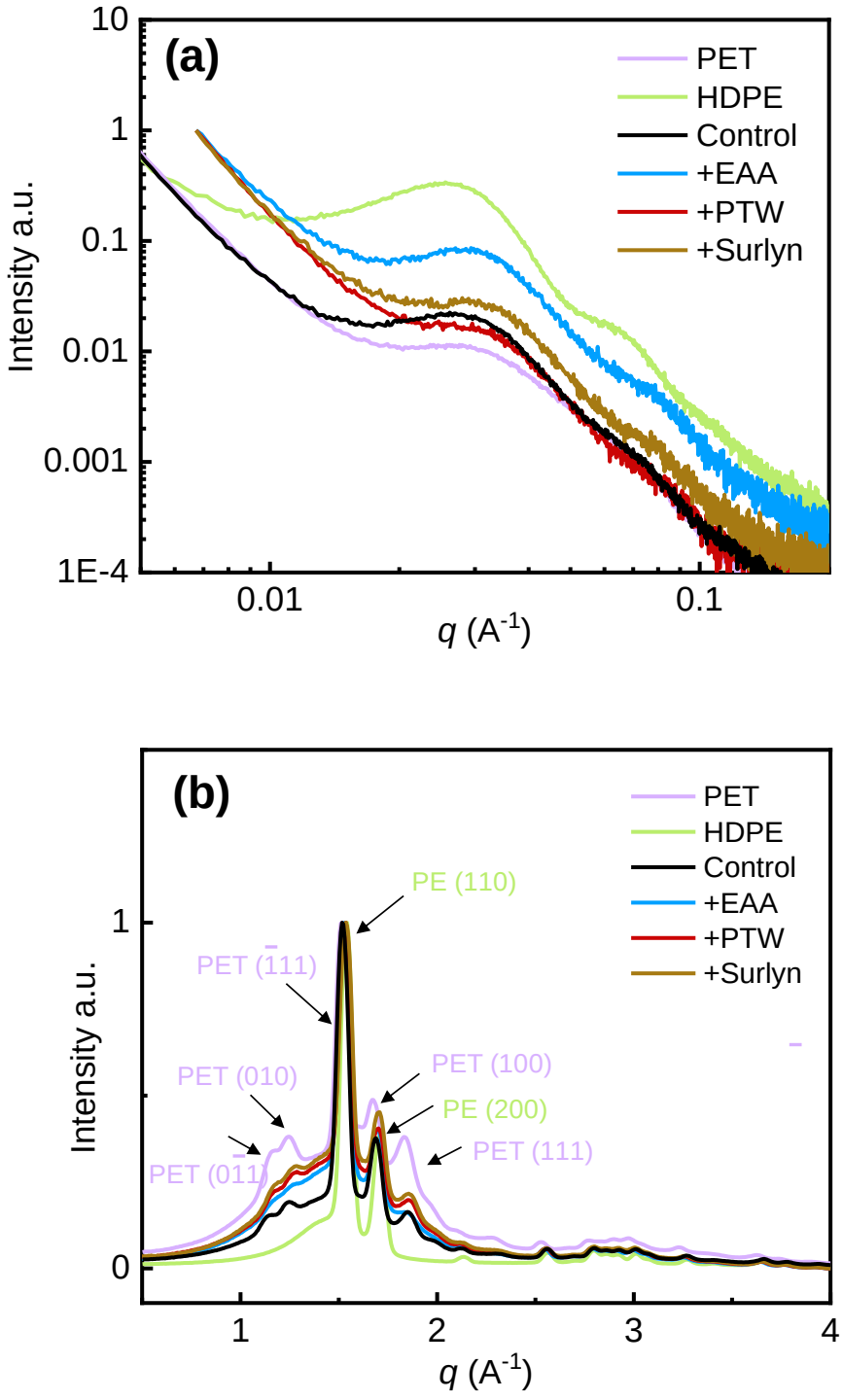

Figure S8 SAXS (a) and WAXS (b) profiles for all samples used in the paper.