Supporting information

Highly Toughened and Robust Polyamide 10,12/MWCNTs Composites Using a Novel 3-15alkyphenol Compatibilizer: Simulations and Experiments

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The Raman spectrum are shown in Figure S1(a).As seen the peaks position of D peak and G peak were located around 1340 cm^{-1} and 1580 cm^{-1}, respectively. The D peak at 1340cm^{-1} could be caused by the defects of carbon nanotubes (CNTs), which might be introduced during CNT grow processing. The G peak in 1580cm^{-1} and the G 'peak in 2700 cm^{-1} were the characteristic peaks of CNTs. It can be clearly seen that the G peak was higher than the D peak, which showed that the less of CNT defects. In Figure S1 (b), it can be clearly observed that CNT was in a tubular winding

state.

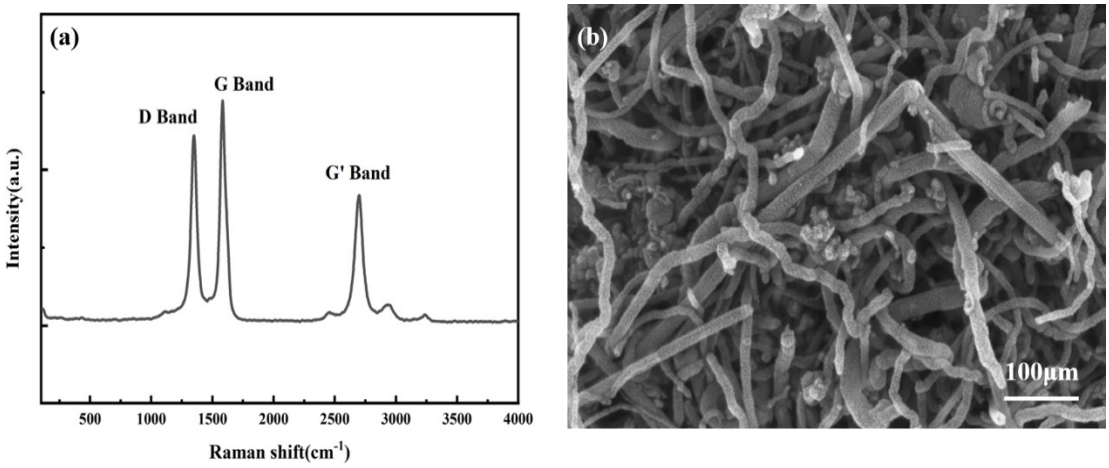

Figure S1 (a) Raman spectra and (b) SEM images of MWCNTs

In order to reveal the H-bonding interactions between PA10,12 and PDP, the IR spectra of multi-walled CNTs and PDP were shown in Figure S2. According to Figure S2, MWCNTs had no obvious absorption peak, while PDP presented numerous absorption peaks. The characteristic absorption peaks of PDP long-chain alkyl are 720 ~ 725cm^{-1} (γ , -CH_2), 1370cm^{-1} and 1456cm^{-1} (δ s/ δ As, -CH_3). 2916cm^{-1} and 2850cm^{-1} (VAS /vs, -CH_2), the phenolic hydroxyl groups in 3363cm^{-1} (v_{OH}) and 1265cm^{-1} (δ_{OH}) produced wider peaks.

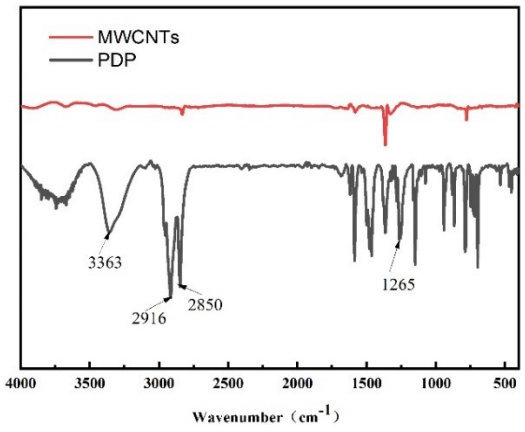

Figure S2 Infrared spectrograms of MWCNTs and PDP

Figure S3 presents the SEM image of the binary PA10,12/CNT composite material. As shown in Figure S3, the agglomeration of CNT could be observed in the binary PA10,12/CNT composite.

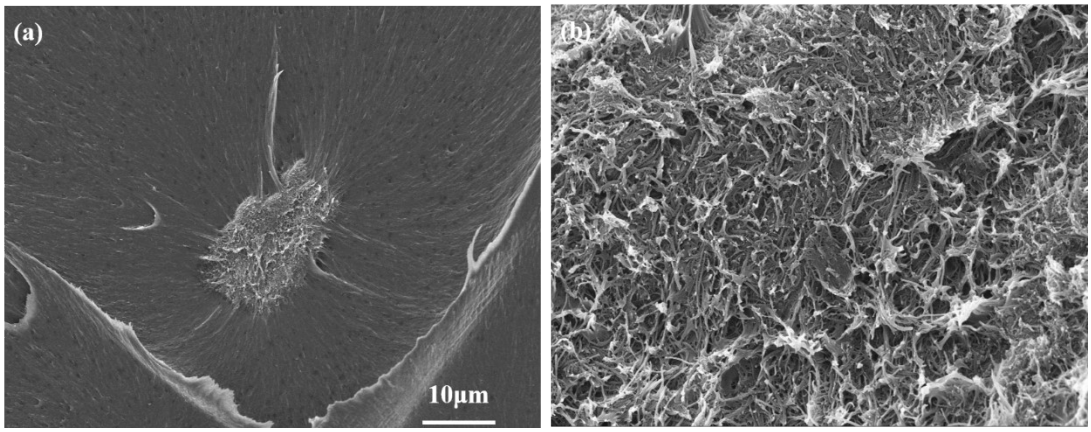

Figure S3. SEM images of PA10,12/CNT composites

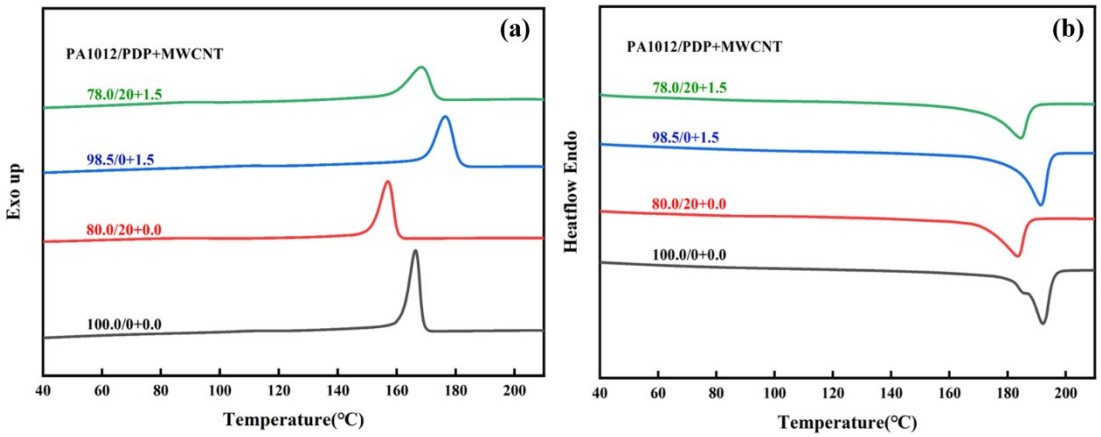

Figure S4. Crystallization (a) and melting (b) curves of PA10,12/CNT composites

The effect of fillers on the crystallization behavior of PA10,12 was studied through the crystallization melting curve for the composite material (Figure S4). The specific values of crystallization peak, half-peak width, melting peak and crystallinity of composites with different CNT contents are listed in Table S1 The crystallinity formula can be expressed as follows[1]:

$$X_c = \frac{\Delta H_m}{\Delta H_m^{\circ}} \times 100\%$$

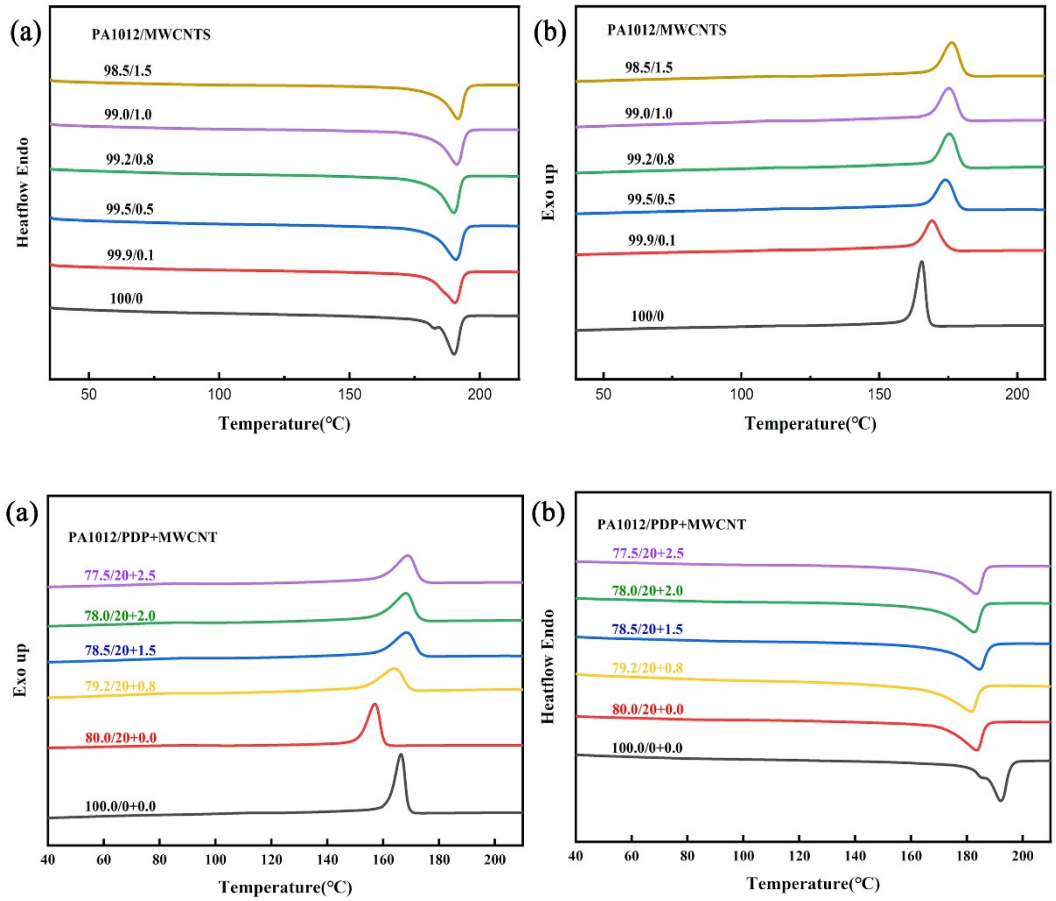

Figure S5. Crystallization and melting curves of pure PA10,12, PA1012/MWCNTs and PA10,12/PDP/CNTs composites.

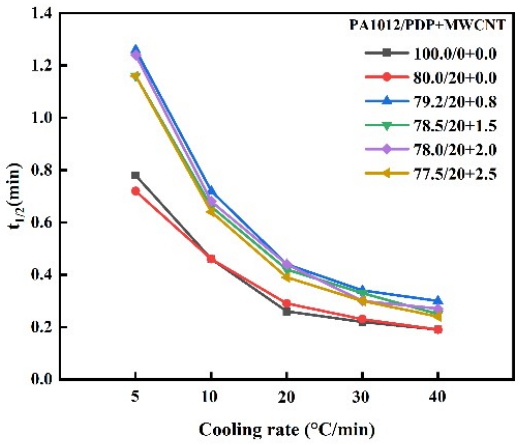

Figure S6. The semi-crystallization time of pure PA10, 12, binary PA10, 12/PDP and ternary PA/PDP/CNT+1.5 composites at different rates

Table S1 Crystallization peak, half-peak width, melting peak and crystallinity of composites with different contents

Samples PA10,12/PDP+MWCNTs	T_C（℃）	T_{oneset}（℃）	T_{oneset}-T_C	T_m（℃）	X_c/%
100.0/0+0.0	166. 5	169	2.5	192.3	18.9
80.0/20+0.0	157.1	160.3	3.2	183.6	16.4
98.5/0+1.5	176.6	181.3	4.6	191.5	22.6
78.5/20+1.5	168.9	173.7	5.5	184.6	18.7

Figure S7 shows the mechanical properties of PA1012 and the ternary system with different amounts of MWCNTs. It can be clearly seen that the composite material as a whole reached a rigid and ductile equilibrium state at the MWCNTs loading of 1.5%.

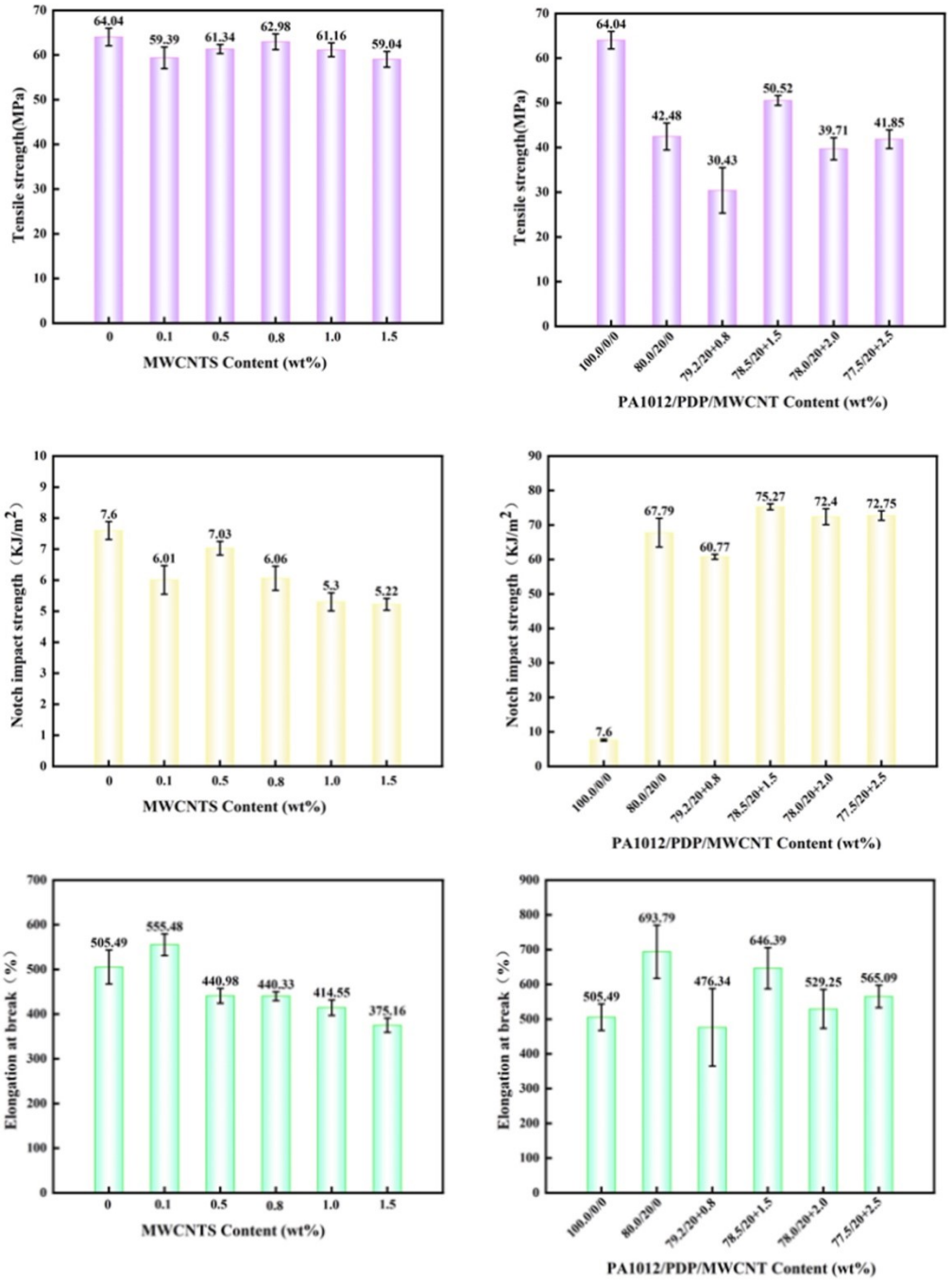

Figure S7. (a) elongation at break (b) notched impact strength (C) tensile strength of PA1012 and ternary PA/PDP/CNT composites

Reefrencses

(1) Quiles-Carrillo, L.; Montanes, N.; Boronat, T.; Balart, R.; Torres-Giner, S. Evaluation of the engineering performance of different bio-based aliphatic homopolyamide tubes prepared by profile extrusion. *Polymer Testing* **2017**, *61*, 421-429. DOI: 10.1016/j.polymertesting.2017.06.004.