

Effect of poly(styrene-co-maleic anhydride) on physical properties and crystalline behavior of nylon-6/PEBA blends

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Abstract This study investigated the effect of blending poly(styrene-co-maleic anhydride) (SMA) on the mechanical and thermal properties of nylon-6/polyether block amide (PEBA) blend. In these blends, nylon-6 was toughened with PEBA using SMA as the compatibilizer. All the blends were prepared via direct melt compounding using a co-rotating twin screw extruder. The amount of PEBA added affected the crystallization characteristics and the relative ratio of γ and α crystalline phases of Nylon 6. The crystallization rate of Nylon 6 was also affected by the cooling rate and the amount of PEBA added. The results of mechanical tests showed that the tensile properties, flexural properties, and impact strengths of the nylon-6/PEBA were all increased when blended with 1 wt% of SMA, at both 23 and -20 °C. However, for neat nylon-6, the impact strength was not affected despite that both tensile and flexural properties were increased by the blending of SMA. The results indicated that SMA can increase the compatibility between nylon-6 and PEBA, thus expanding the usage of nylon-6/PEBA blend in low-temperature applications.

Keywords Nylon 6 · Polyether block amide · Poly(styrene-co-maleic anhydride) · Mechanical properties

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Introduction

Nylon is a thermoplastics with excellent mechanical properties, and is widely employed as engineering plastics. However, its impact strength is low at temperature below 0 °C. This limits the application of nylon in low temperature climate. Improving the impact strength below 0 °C has become an important issue in the modification of nylon. In particular, the toughening of nylon has been studied extensively in the literature [1–26].

In general, the toughening is achieved by melt-blending the matrix with an elastomer possessing T_g far below room temperature. In the literature, the polymers chosen for toughening nylon included styrene-(ethylene-co-butylene)-styrene triblock copolymer (SEBS) [2, 4, 9, 14], polyethylene-octene elastomer (POE) [5, 11, 13, 16, 18, 21, 22], ethylene-propylene rubber (EPR) [2, 4, 12], ethylene-propylene diene copolymer (EPDM) [1, 3, 4, 6, 8, 17], ethylene-vinyl acetate copolymer (EVA) [7, 10, 15, 18, 21], natural rubber (NR) [26], fluoroelastomer [25], polyethylene (PE) [23], and polypropylene (PP) [2, 10, 17, 24]. These polymers are all non-polar, making them incompatible with polar nylon. In order to improve the compatibility to improve the toughening effect, compatibilizing modification was extensively investigated.

Poly(styrene-co-maleic anhydride) (SMA) has been used to improve the compatibility between nylon and other polymers [27, 28]. Toughened nylon has wide range of application including bumper, fender, snow boots, snow shoes, roller skates, fitness equipment, baby car, bicycle accessories, wheels, and office furniture.

The mechanical properties of Nylon 6, such as tensile strength, hardness, low temperature brittleness, notch sensitivity, etc., are affected by the crystalline characteristics. As a result, the methods of blending Nylon 6 with high molecular weight polymers were investigated to improve the crystalline

properties [29–38]. These polymers included cyclodextrin, starch, polystyrene (PS), Nylon 66, ABS, poly(vinylidene fluoride) (PVDF), poly(propyl oxide) (PPO), cellulose, acrylate, PP, PE, styrene-butadiene rubber (SBR), acrylate rubber, EPDM, polyethylene-propylene rubber, etc. [24, 29, 39–50]

Poly(ether-block-amide) (PEBA) (Scheme 1) is a thermoplastic elastomer made from flexible polyether and rigid polyamide 11 based on renewable resources [51–54]. In this study, PEBA was employed as the toughening agent for Nylon 6, and SMA (Scheme 2) was used as the compatibilizer. The resultant nylon blend was subject to measurements of mechanical properties, impact strength, and crystallization behaviors. Based on these results, the effect of blending with toughening agent and compatibilizer on the mechanical properties of Nylon 6 was evaluated.

Experimental

Materials

Table 1 summarizes the properties of the materials used in this study. Neat Nylon 6 (Zisamide TP4208, ZigSheng, Taiwan) has a relative viscosity (RV) of 2.4 ($\bar{M}_w = 20.5$ kD with PDI 1.38) and the density of amino end-groups was $44 \mu\text{eq g}^{-1}$. Polyether block amide (PEBA) (Pebax® Rnew 40R53 SP 01) was purchased from Arkema, France. The compatibilizer, SMA, was purchased from Sigma-Aldrich, USA, with a mole ratio of styrene to maleic anhydride of 1.3 to 1.

Blending

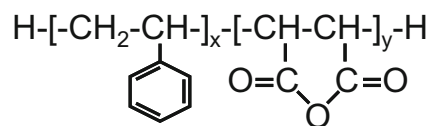
Table 2 lists the formulation of the blends. Before processing, all materials were dried for 12 h at 80°C in a vacuum oven to ensure removal of water. Blends were prepared in a co-rotating twin screw extruder ($L/D = 42$, $L = 1.05$ m) (ZE 25A \times 42D, Thermo-Haake, Germany) operating at a screw speed of 250 rpm and a temperature profile of 205, 220, 225, 230, 235, 240, 245, 250, and 255°C (die). Table 3 lists the details of the processing conditions.

DSC analyses

A Perkin-Elmer DSC-7 was used to measure the endotherms and exotherms of different specimens under the nitrogen environment at a nitrogen flow rate of 40 ml/min. The dynamic thermograms were obtained from specimens at a heating rate of $10^\circ\text{C}/\text{min}$ from -40°C to 230°C (1st heating scan), held at 230°C for 5 min to erase the thermal history, subsequently



Scheme 1 Chemical structure of poly(ether-block-amide)



Scheme 2 Chemical structure of poly(styrene-co-maleic anhydride)

cooled to -40°C at a cooling rates of either 5 or $10^\circ\text{C}/\text{min}$, and then reheated to 230°C at a heating rate of $10^\circ\text{C}/\text{min}$ (2nd heating scan). At least three specimens prepared from hermetic aluminum (Al) pans were tested for each DSC measurement. The thermograms obtained were calibrated by the baseline obtained from the empty Al pan and the indium standard.

The crystallinity of Nylon 6 blends is calculated as follows,

$$X_c = \frac{\Delta H_m}{\Delta H_{\text{ref}}} \times \frac{1}{w} \times 100\%$$

where X_c is the crystallinity, ΔH_m is the experimental heat of fusion at melting point determined by DSC, ΔH_{ref} is the theoretical heat of fusion of 100% fully crystalline Nylon 6 (241 J/g) [31] and w is the weight fraction of Nylon 6 in blends.

X-ray diffraction (XRD)

The hot pressed samples (pressed at 230°C and cooled at the room temperature with a thickness about $120 \mu\text{m}$) were conditioned in the oven at 80°C (above the glass transition temperature of Nylon 6) for 24 h before XRD analyses. The diffraction patterns of the various samples were obtained using Cu ($K\alpha$) X-rays in a Bruker d2 phaser at a scanning rate of $0.04^\circ/\text{min}$.

Mechanical properties

The extruded pellets were injection molded into standard 0.318 cm thick Izod (ASTM D256) and tensile (ASTM D638 with type I) bars using an injection molding machine (VS-100 M, Victor Taichung Machinery Works Co., Taiwan). In addition, the flexural specimen bars were prepared as specified by ASTM D790. The barrel temperature was set up at 255°C (nozzle) and the molding temperature at 80°C . An injection pressure of 8 MPa and a holding pressure of 3.5 MPa were applied. The details of the processing conditions were described in Table 3.

Notched Izod impact strength was determined using an impact tester (Cs137–25, Atlas Co., Germany). The tensile testing was performed using an Instron tester (type 5567) at a crosshead speed of $50 \text{ mm}/\text{min}$ for strength measurements and $5 \text{ mm}/\text{min}$ for modulus measurements. In addition, flexural testing was performed also using an Instron tester (type 5567) at a crosshead speed of $14 \text{ mm}/\text{min}$ for strength measurements and $1.4 \text{ mm}/\text{min}$ for modulus measurements.

Table 1 Materials used in this study

Material	Commercial name	Description	Source
Nylon6	Zisamide TP4208	R.V. = 2.4 and 44 $\mu\text{eq g}^{-1}$ of amine end-groups	ZigSheng
Polyether block amide (PEBA)	Pebax® Rnew 40R53 SP 01	A thermoplastic elastomer made of flexible polyether and rigid polyamide 11	Arkema
Poly(styrene-co-maleic anhydride) (SMA)	--	mole ratio of styrene:maleic anhydride:1.3:1	Sigma-Aldrich

All specimens were kept in a sealed desiccator under vacuum for 24 h before measuring mechanical properties. The values reported were an average from five measurements.

Results and discussion

Crystallization characteristics from DSC

In general, the molecules in the crystalline and amorphous regions of Nylon 6 all can form strong hydrogen bonds because of their highly polar chemical structures. These strong hydrogen bonds restrict the intermolecular movements and regular alignment of chains, consequently, limit greatly the extent of crystallinity in Nylon 6. Nylon 6 usually has crystallinity near 30% and exhibits polymorphic structures with α and γ crystalline phases. The monoclinic α phase with intra-sheet hydrogen bonds is more stable and has a higher modulus than the metastable hexagonal γ and pseudohexagonal γ^* phases with inter-sheet hydrogen bonds. Consequently, the structural differences between the α and γ phases could affect the physical and mechanical properties of Nylon 6. [34–36]

The processing conditions significantly affect the crystalline structures formed in Nylon 6. It was found that the relatively faster and slower crystallization rate would facilitate the formation of γ and α phases, respectively. A higher crystallization temperature also enhances the growth of α phase but a lower crystallization temperature enhances the growth of γ phase. The α

phase is usually observed in solvent casting and annealed specimens while the γ phase is usually obtained in melt spinning and nanocomposite samples. These crystalline phases are interchangeable. The α phase can transform into γ and γ^* phases or the high temperature monoclinic structure when heated. The γ phase can also change to α phase through a melting-recrystallization process when heated using a slow heating rate. The simple Nylon polymers contain mostly crystalline γ phase. [29, 30, 34–36]

Factors including heating condition, stress, molecular weight, additive, and humidity can all affect the crystallization of Nylon 6 in various degrees. Among these factors, the molecular weight significantly changes the crystallization characteristics of Nylon 6. Both low and high molecular weight Nylon 6 would form γ phase crystals at a low crystallization temperature, undergo $\gamma \rightarrow \alpha$ phase transition at a middle temperature as heated, and then change to α phase at a high temperature. However, the melt of the low molecular weight Nylon 6 follows three processes while that of the high molecular weight Nylon 6 goes through five processes and has a transition zone during the melt. [30, 31, 38]

The effect of PEBA on the crystallization behavior of Nylon 6 can be observed from the cooling exotherms in Fig. 1. Table 4 summarizes the crystallization characteristics of these samples. The sample without PEBA (STN-1) exhibited higher onset temperature ($T_{\text{onset}} = 188.2 \text{ }^\circ\text{C}$) and crystallization temperature ($T_c = 184.7 \text{ }^\circ\text{C}$) and lower crystallization half-time ($t_{1/2} = 0.34 \text{ min}$) than those samples with PEBA (STN-2 ~ 5), indicating that the presence of PEBA hindered the crystallization of Nylon 6. The reason is that the flexible PEBA has much lower crystallization temperatures

Table 2 Formulation of blends

Sample composition	Nylon6	PEBA	SMA
STN-1	99	0	1
STN-2	84	15	1
STN-3	79	20	1
STN-4	74	25	1
STN-5	64	35	1
STN-1-A	100	0	0
STN-2-A	85	15	0

Table 3 Processing conditions used in this study

Equipment type	Processing conditions	Manufacturer
Co-rotating twin screw extruder (ZE 25Ax42D)	Screw speed:250 rpm Barrel temp.:205 ~ 255 $^\circ\text{C}$ Feed rate: 6 kg/h L/D: 42	Thermo Haake (Berstorff Co., Germany)
Injection molding (VS-100 M)	Barrel temp.:245 ~ 255 $^\circ\text{C}$ Injection pressure: 8.0 MPa Holding pressure: 3.5 MPa Molding temp.:80 $^\circ\text{C}$	Victor Taichung Machinery Works Co., Taiwan

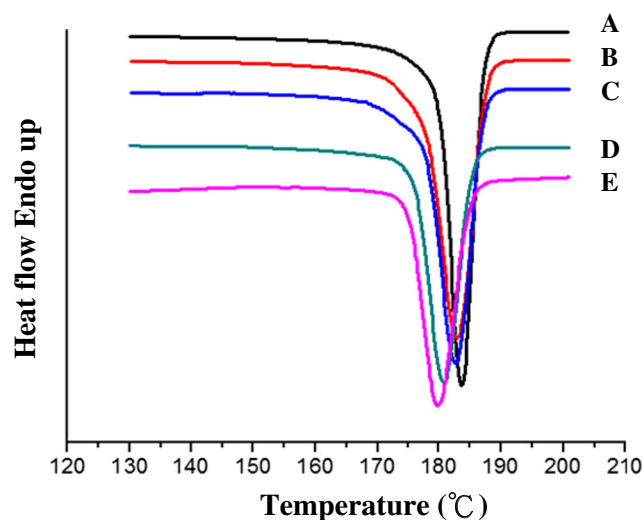


Fig. 1 The 1st cooling thermograms at a cooling rate of 10 °C/min for samples A: STN-1, B: STN-2, C: STN-3, D: STN-4, and E: STN-5

($T_{\text{onset}} = 127.4$ °C and $T_c = 116.4$ °C), and much smaller crystallization enthalpy ($\Delta H_c = 25.5$ J/g). Thus the addition of PEBA adversely affected the crystallization of Nylon 6 during the cooling process.

Table 4 also lists the crystallinity of the Nylon 6 constituent in these samples. The theoretical heat of fusion of 100% crystalline Nylon 6, 241 J/g, was used to calculate the crystallinity [31, 55]. Various values (230 ± 20 J/g) other than 241 J/g have been proposed for the fully crystallized α crystals of Nylon 6 [56–59] depending on the source of Nylon 6. The value used here was good for comparison purpose. The crystallinities of all the samples varied little around 27 to 28%, indicating that the crystallinity of Nylon 6 was little affected by PEBA. As a result, regardless of the presence of different amounts of PEBA, the constituent of Nylon 6 in the samples can crystallize well and attain a high crystallinity near the highest possible crystallinity of 30% for Nylon 6 [31].

Figure 2 shows the 2nd heating curves at a heating rate of 10 °C/min. Table 5 summarizes the melting characteristics of Nylon 6 in these samples. The melting endotherms were affected by the addition of PEBA. In general, all the samples exhibited three clear melting peaks at temperatures above

Table 4 The crystallization characteristics of Nylon 6 at a cooling rate of 10 °C/min

Sample	T_{onset} (°C)	T_c (°C)	ΔH_c (J/g)	X_c (%)	$t_{1/2}$ (min) ^a
STN-1	188.2 ± 0.9	184.7 ± 0.9	64.3 ± 0.7	26.8 ± 0.3	0.34 ± 0.01
STN-2	187.7 ± 0.6	183.2 ± 0.5	63.8 ± 2.6	26.6 ± 1.1	0.46 ± 0.01
STN-3	187.3 ± 0.3	183.3 ± 0.5	65.7 ± 1.4	27.4 ± 0.6	0.41 ± 0.03
STN-4	185.4 ± 0.1	181.1 ± 0.3	66.6 ± 2.4	27.8 ± 1.0	0.43 ± 0.03
STN-5	185.0 ± 0.1	180.2 ± 0.2	68.0 ± 0.2	28.3 ± 0.0	0.47 ± 0.01

^a Measured at a cooling rate of 10 °C/min

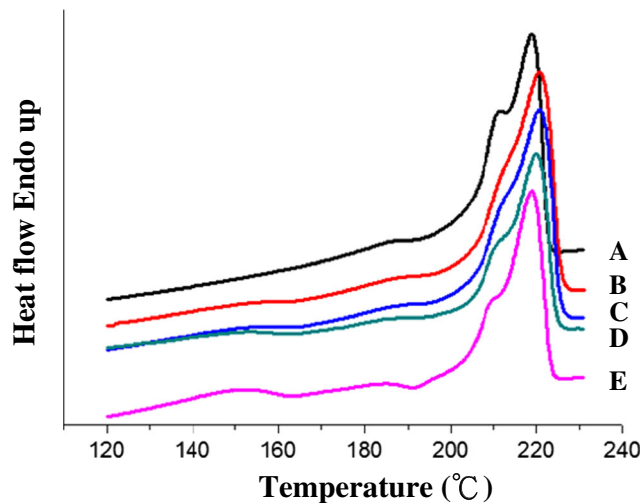


Fig. 2 The 2nd heating thermograms at 10 °C/min after cooling at 10 °C/min for samples a STN-1, b STN-2, c STN-3, d STN-4, and e STN-5

180 °C. The smaller peaks near 183 ~ 189 °C (T_{m1}) are due to the small crystallites melted at the relatively lower temperature. The melting peaks at 210 ~ 212 °C (T_{m2}) are due to the melting of γ crystals, and the largest peaks near 219 ~ 220 °C (T_{m3}) are resulted from the melting of α crystals. These 3 melting temperatures were not much affected by the addition of PEBA. This result is consistent with the previous results that the crystallinity of Nylon 6 is little affected by PEBA.

Table 5 also shows that ΔH_m of Nylon 6 was not much affected by the addition of PEBA. However, Fig. 2 shows that the relative intensities of three melting peaks varied with the content of PEBA. The samples STN-2 ~ STN-5 exhibited higher contents of α crystals than STN-1. Higher PEBA content led to less γ phase and more α phase. This is due to the different crystallization rate and crystallization temperature experienced among samples because of which affected the formation of α and γ crystals. Lower PEBA content could result in a higher crystallization rate and thus facilitate the formation of γ phase. This is consistent with the T_{onset} and T_c obtained previously. Furthermore, higher content of PEBA elastomer also resulted in a decrease of the glass transition temperature (T_g) of Nylon 6 samples confirmed by the lower

Table 5 The melting characteristics of Nylon 6 at a cooling rate of 10 °C/min

Sample	T_g (°C)	ΔH_m (J/g)	T_{m1} (°C)	T_{m2} (°C)	T_{m3} (°C)
STN-1	54.0 ± 1.9	70.0 ± 0.6	186.4 ± 0.9	212.2 ± 0.2	219.6 ± 0.6
STN-2	53.0 ± 1.1	69.9 ± 1.5	188.3 ± 1.4	211.5 ± 0.4	220.5 ± 0.6
STN-3	53.0 ± 1.6	69.9 ± 0.4	188.5 ± 2.9	211.1 ± 0.4	220.1 ± 0.6
STN-4	49.8 ± 1.2	70.9 ± 1.6	183.8 ± 0.6	210.3 ± 0.6	219.3 ± 0.5
STN-5	50.7 ± 1.8	72.5 ± 1.6	183.6 ± 0.3	209.8 ± 0.4	219.1 ± 0.3

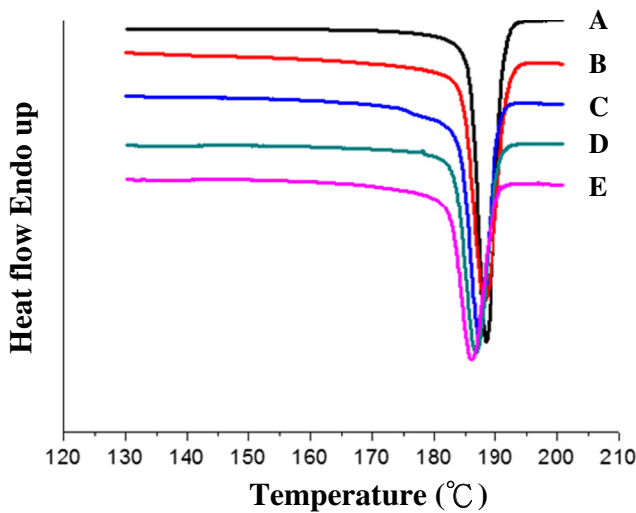


Fig. 3 The 1st cooling thermograms at a cooling rate of 5 °C/min for samples **a** STN-1, **b** STN-2, **c** STN-3, **d** STN-4, and **e** STN-5

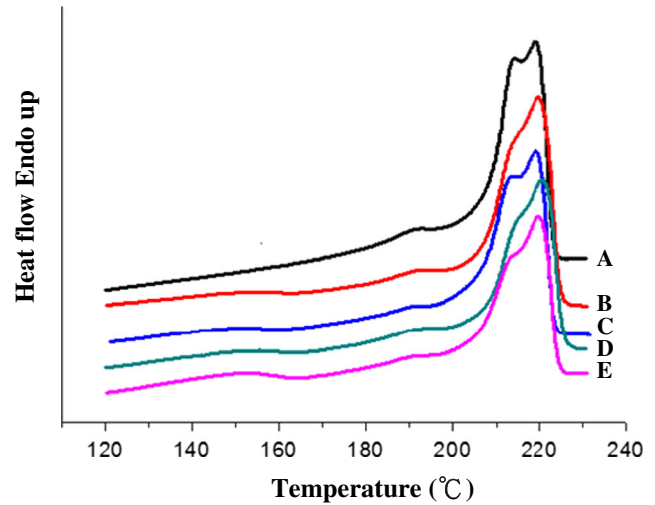


Fig. 4 The 2nd heating thermograms at 10 °C/min after cooling at 5 °C/min for samples **a** STN-1, **b** STN-2, **c** STN-3, **d** STN-4, and **e** STN-5

T_{ig} 's of STN-4 and STN-5 than those of STN-1 ~ STN-3 (see Table 5).

In Table 5 also shows the melting enthalpies (ΔH_m) of the samples. Comparing to ΔH_c listed in Table 4, all ΔH_m were greater than ΔH_c due to the cold crystallization and secondary crystallization happening during the 2nd heating process. Regardless of the sample type, the difference between ΔH_m and ΔH_c is limited because the crystallinity obtained is already high in the previous cooling process.

The crystallization behaviors were also measured by using cooling rates of 5 °C/min to investigate the effect of cooling rate on the crystallization characteristics of Nylon 6 (see Fig. 3). These characteristics were summarized in Table 6. As expected, T_{onset} and T_c increased at lower cooling rate for all the samples due to the kinetic effect on the crystallization process. In addition, the lower cooling rate also resulted in a longer crystallization time and a higher crystallinity of Nylon 6 than at a faster cooling condition by comparing results shown in Tables 4 and 6. It is reasonable to see in Fig. 4 that the larger melting endotherms at T_{m2} due to the melting of γ crystals than those in Fig. 2 are obtained because of the different crystallization rates.

Table 6 The crystallization characteristics of Nylon 6 at a cooling rate of 5 °C/min

Sample	T_{onset} (°C)	T_c (°C)	ΔH_c (J/g)	X_c (%)
STN-1	191.1 ± 0.1	187.6 ± 1.1	70.0 ± 1.4	29.2 ± 0.6
STN-2	191.3 ± 1.0	187.8 ± 0.8	67.6 ± 1.4	28.2 ± 0.6
STN-3	191.3 ± 0.8	188.1 ± 0.7	68.7 ± 2.5	28.6 ± 1.0
STN-4	191.0 ± 0.7	187.4 ± 0.5	68.3 ± 2.2	28.4 ± 0.9
STN-5	191.0 ± 0.3	187.1 ± 0.5	70.5 ± 3.3	29.4 ± 1.3

Figure 5 shows the XRD patterns taken from samples after annealing at 80 °C. All five samples exhibited small shoulders near 21.3° and large main peaks near 23.6° which were from (001) plane of γ phase and (002)/(202) planes of α phase, respectively. The result indicated that a relatively smaller amount of γ phase was in these samples comparing to the DSC samples due to the use of different cooling (crystallization) and 2nd heating processes.

Mechanical properties

Table 7 summarizes the mechanical properties of Nylon 6/SMA/PEBA blends, including impact properties, tensile properties and flexural properties.

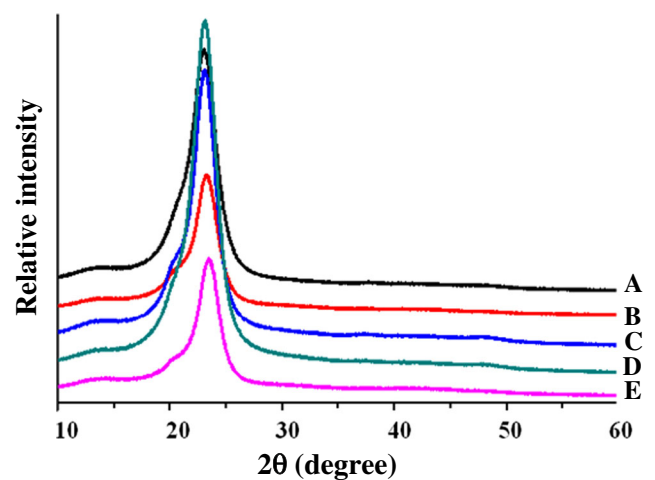


Fig. 5 The X-ray diffraction patterns for samples **a** STN-1, **b** STN-2, **c** STN-3, **d** STN-4, and **e** STN-5

Table 7 Mechanical properties of blends

Sample composition	Izod impact strength (J/m)		Tensile strength (MPa)	Tensile modulus (GPa)	Flexural strength (MPa)	Flexural modulus (GPa)
	23 °C	-20 °C				
STN-1	62.5 ± 3.1	47.6 ± 2.3	64.2 ± 1.3	2.81 ± 0.02	104.0 ± 1.6	2.05 ± 0.02
STN-1-A	64.3 ± 2.8	48.3 ± 2.1	60.0 ± 0.8	2.58 ± 0.02	97.7 ± 1.2	1.94 ± 0.01
STN-2	191.2 ± 8.2	130.9 ± 6.1	58.3 ± 0.9	1.96 ± 0.03	69.9 ± 0.8	1.33 ± 0.01
STN-2-A	128.6 ± 5.9	96.2 ± 4.5	51.8 ± 1.1	1.74 ± 0.03	60.8 ± 0.8	1.18 ± 0.01
STN-3	222.6 ± 8.1	145.2 ± 6.7	55.0 ± 1.2	1.83 ± 0.02	64.7 ± 0.9	1.26 ± 0.01
STN-4	243.5 ± 9.2	163.1 ± 7.1	45.0 ± 0.9	1.60 ± 0.02	52.3 ± 0.7	1.06 ± 0.01
STN-5	351.8 ± 9.7	242.2 ± 9.1	42.5 ± 1.0	1.42 ± 0.03	47.3 ± 0.6	0.90 ± 0.01

Impact test

Figure 6 shows the results of impact test of Nylon 6 and its blends. The impact strength of neat Nylon 6 (STN-1-A) was 64.3 ± 2.8 J/m at 23 °C while that of Nylon 6/1 wt% SMA (STN-1) was 62.5 ± 3.1 J/m at 23 °C. The difference was insignificant. Similarly, the impact strengths at -20 °C were 48.3 ± 2.1 J/m and 47.6 ± 2.3 J/m for STN-1-A and STN-1, respectively. This indicates that the addition of 1 wt% SMA did not affect the impact strength of Nylon 6. However, for the blends of Nylon 6/PEBA, the presence of 1 wt% SMA did improve greatly the impact strength, both at 23 and -20 °C. In the case of STN-2, which contained 15 wt% of PEBA, the impact strength was significantly increased by 49% and 36% at 23 and -20 °C, respectively. The increase can be attributed to the improvement in the compatibility between Nylon 6 and PEBA by the compatibilizer, SMA.

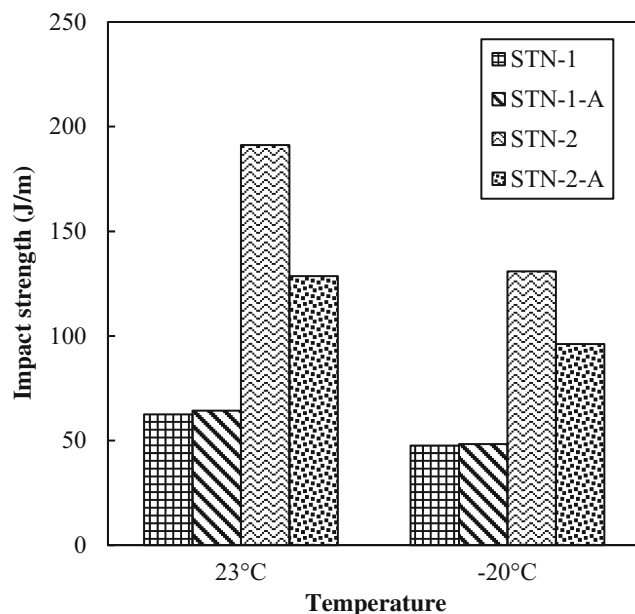
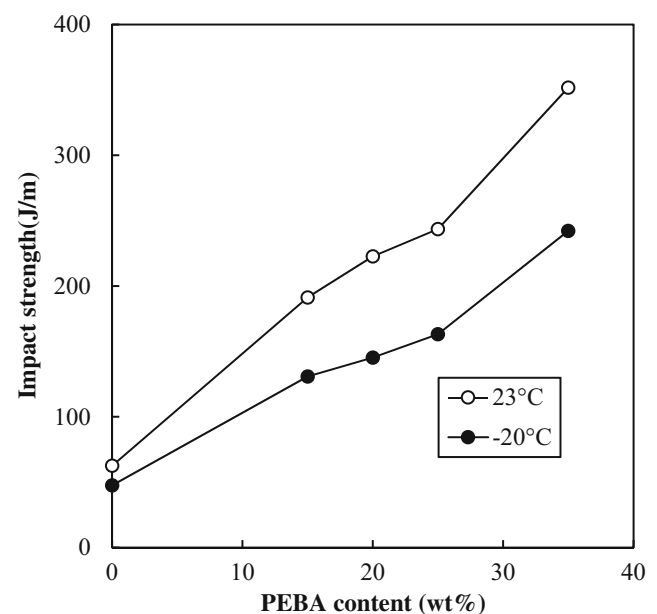
**Fig. 6** Izod impact strength of Nylon6 and Nylon 6/1 wt% of SMA at 23 °C and -20 °C

Figure 7 shows the effect on PEBA content on the impact strength of the Nylon 6/PEBA/SMA blends. The impact strength of the blend increased with the PEBA content. In particular, the blend containing 35 wt% of PEBA (STN-5) exhibited an impact strength 5.47 folds of that without PEBA (STN-1) at 23 °C, and 5 folds at -20 °C. This indicates that the presence of PEBA can greatly improve the impact strength of Nylon 6.

The improvement in the impact strength by PEBA is from the flexible polyether segment. As indicated in the literature, flexible molecular chains can increase the impact properties of Nylon 6 [5, 6, 16].

Tensile properties

Figure 8 shows the effect of PEBA on the tensile properties of STN with 1 wt% SMA. The tensile strength decreased slightly by 9% when the PEBA content was below 15%, while that

**Fig. 7** The effect of PEBA content on the Izod impact strength of Nylon 6/1 wt% SMA at 23 °C and -20 °C

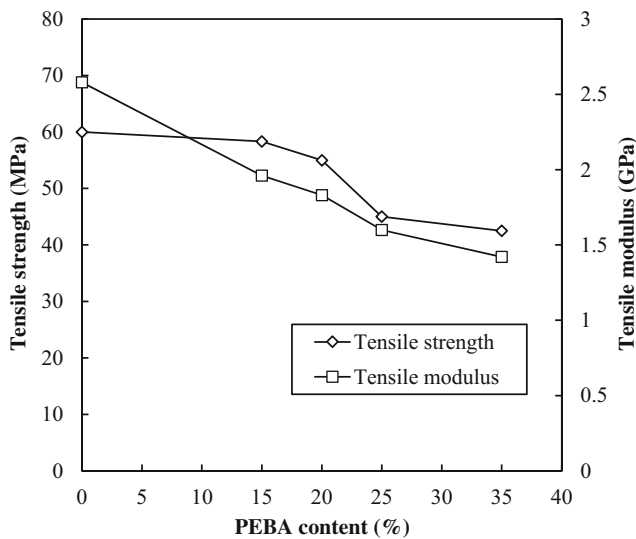


Fig. 8 The effect of PEBA content on the tensile properties of Nylon 6/1 wt% SMA

decreased drastically by 33% when PEBA content was increased to 35%. This can be attributed to the presence of lower-strength PEBA. On the other hand, the tensile modulus decreased almost linearly from 2.81 to 1.42 GPa with the increase of PEBA content. This is because PEBA diluted the crystalline Nylon 6 and making the blend softer.

Flexural tests

Figure 9 shows the effect of PEBA content on the flexural properties of Nylon 6/1 wt% SMA. The flexural strength and modulus decreased by 55% and 56%, respectively, when the PEBA content increased to 35 wt%. This is reasonable since PEBA is a soft polymer with a flexural modulus of only 75 MPa [60].

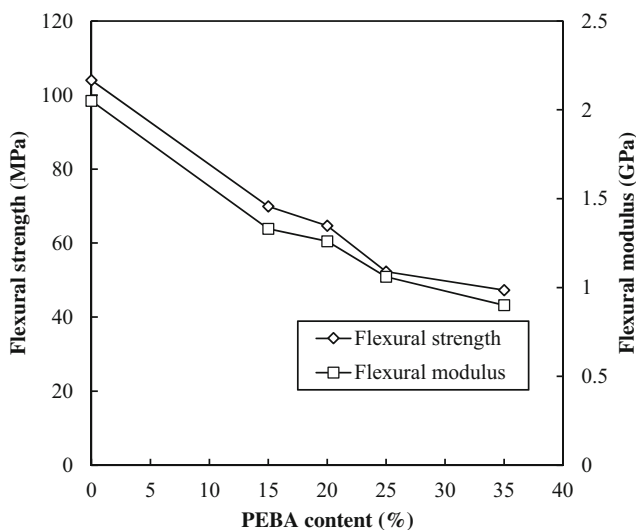


Fig. 9 The effect of PEBA content on the flexural properties of Nylon 6/1 wt% SMA

Conclusions

The mechanical properties of Nylon 6 were affected by melt-blending PEBA. In addition, by adding a compatibilizer (SMA), the compatibility between Nylon 6 and PEBA was improved, as revealed by the increase in the mechanical properties. The impact strength of the blend with 15% of PEBA was about 200% of that of neat Nylon 6 at 23 °C, and with the addition of 1% of SMA, the impact strength was about 300% of that of neat Nylon 6. Furthermore, the reduction in the impact strength at -20 °C was smaller for the blend of Nylon 6/PEBA than neat Nylon 6. This preserving in the impact strength was further increased when SMA was added. In addition, the impact strength increased with the content of PEBA and SMA.

The results of DSC indicated that the presence of PEBA would affect the crystallization rate and the relative ratio of γ and α crystalline phases formed in Nylon 6. The amount of PEBA added changed the crystallization characteristics and also the relative amounts of γ and α crystals in Nylon 6. It was confirmed that the cooling rate and the amount of PEBA added could considerably affect the crystallization rate of Nylon 6.

Unlike impact strength, the tensile strength and modulus of the blend decreased with the increase of the content of PEBA and SMA. Similarly, the flexural properties also decreased with the increase of the content of PEBA and SMA. However, the extent of reduction was around 30 ~ 50%, which was acceptable considering the improvement in the impact strength.

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