

NOTES

Compatibilizing Effect of Poly(methyl methacrylate) in Polycarbonate/Poly(acrylonitrile-co-butadiene-co-styrene) Blend

INTRODUCTION

Polymer alloys can combine attractive properties of component polymers. However, immiscible blends often have poor mechanical properties because of poor adhesion at the interface. For the improvement of interfacial conditions, it has been reported that a homopolymer as well as block or graft copolymers can be used effectively as a polymeric surfactant.¹⁻³

Poly(acrylonitrile-co-butadiene-co-styrene) (ABS) is a two-phase system where polybutadiene is dispersed as a minor phase in the matrix of poly(styrene-co-acrylonitrile) (SAN). So, in the polycarbonate (PC)/ABS blend, the interaction between PC and SAN is an important factor for optimum compatibility. The interaction between PC and SAN is strongly influenced by the acrylonitrile (AN) content in SAN. It has been reported that the SANs whose AN content is in the range of 15–30 wt % show better compatibility with PC than do SANs outside this range.⁴⁻⁶

Cheng et al.⁷ observed in the PC/SAN blend that an impact modifier with a poly(methyl methacrylate) (PMMA) shell distributes at the SAN phase when the AN content in SAN is 25 wt % and distributes at the interface and PC phase when the AN content in SAN is 34 wt %. These results suggest that PMMA can change the interfacial conditions of the PC blend with SAN having an AN content near 34 wt %. In this note, we report the compatibilizing effect of PMMA in a PC/ABS blend when the AN content of SAN in ABS is near 34 wt %.

EXPERIMENTAL

Commercial grades of resins, with the physicochemical properties listed in Table I, were used as received. Talc with average size of 5 μm was used without surface treatment.

Dried resins were hand-mixed thoroughly at the compositions described in Table II, followed by melt blending

using a corotating twin-screw extruder (Berstorff ZE25, $L/D = 33$) at a zone temperature profile of 240–270°C and 300 rpm. Extrudates were quenched in water and pelletized. Injection molding was done at a temperature similar to that for blending.

The morphology of the blends were measured using a scanning electron microscope (SEM, JEOL JSM 820) and a transmission electron microscope (TEM, JEOL JEM 1200 EX II). SEM photographs were taken from the cryogenically (in liquid nitrogen) fractured surface and sputtered with gold before viewing. For the observation of TEM, tensile specimens were stained with OsO_4 , followed by cutting with a microtome to obtain a thin film. Tensile properties and $\frac{1}{4}$ in. notched Izod impact strength of the injection-molded specimen were determined following the standard procedures described in ASTM D638 and D256, respectively.

RESULTS AND DISCUSSION

In Figure 1(a), the voids at the interface between the PC matrix and dispersed ABS particles show poor interfacial adhesion in the unmodified blend. This shows the incompatibility of PC and ABS whose average AN content in SAN is 34–35 wt %.⁴⁻⁶ However, in Figure 1(b) and (c), as some of the SAN is replaced by PMMA, the dispersed ABS particles become much smaller and the interface between phases becomes obscure. The same trends can also be observed with blends containing talc, as shown in Figure 1(d)–(f). These results imply the enhanced interfacial wettability of PC/ABS blends modified by PMMA. This change in morphology can also be observed in Figure 2, i.e., the ABS domains with stained rubber particles become smaller in blends modified by PMMA, probably due to the compatibilizing effect of PMMA.

Table III shows the mechanical properties of the blends studied, where we can observe the enhancement of elongation at break and Izod impact strength in blends modified by PMMA. Also, this enhancement of mechanical properties is more evident in blends containing talc. Better

Table I Characteristics of Polymers Used in This Study

Resin Notation	Weight-average Molecular Weight	Number-average Molecular Weight	Melt Index (g/10 min)	Composition of Monomeric Repeating Unit by Weight
PC	22,800	9760	—	—
ABS	—	—	3.0 ^a	Acrylonitrile : butadiene : styrene = 25 : 27 : 48
SAN	54,500	34,000	—	Styrene : acrylonitrile = 65 : 35
PMMA	66,000	35,000	—	—

^a Measured at 220°C with 10 kg load.

Table II Compositions of Blends Studied

Designation	Composition by Weight				
	PC	ABS	SAN	PMMA	Talc
MM0	70.0	23.9	6.1	—	—
MM3	70.0	23.9	3.1	3.0	—
MM6	70.0	23.9	—	6.1	—
MM0T	70.0	23.9	6.1	—	7.5
MM3T	70.0	23.9	3.1	3.0	7.5
MM6T	70.0	23.9	—	6.1	7.5

adhesion at the interface and finer dispersion of ABS domains with rubber particles seem to be the causes of these improved mechanical properties.⁸ All these results show that PMMA can compatibilize the PC blend with ABS whose AN content in SAN is 34–35 wt %.

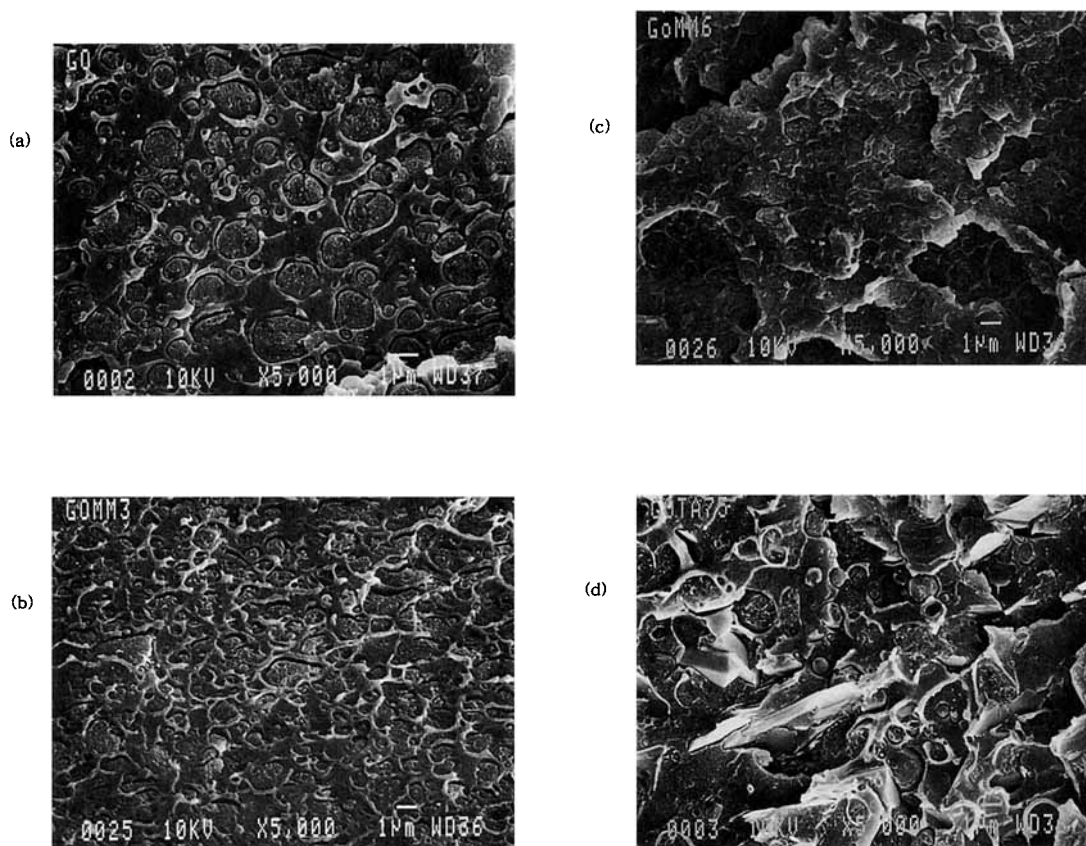


Figure 1 SEM micrographs of PC/ABS blends: (a) MM0; (b) MM3; (c) MM6; (d) MM0T; (e) MM3T; (f) MM6T.

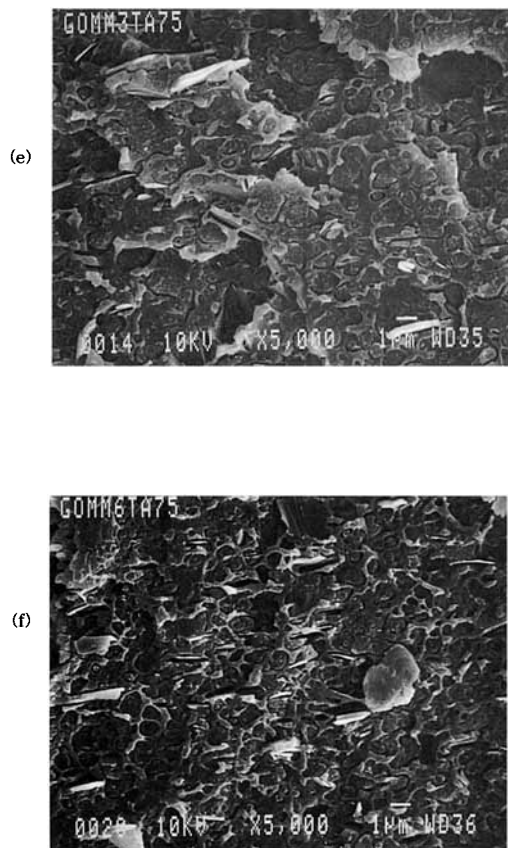


Figure 1 (Continued)

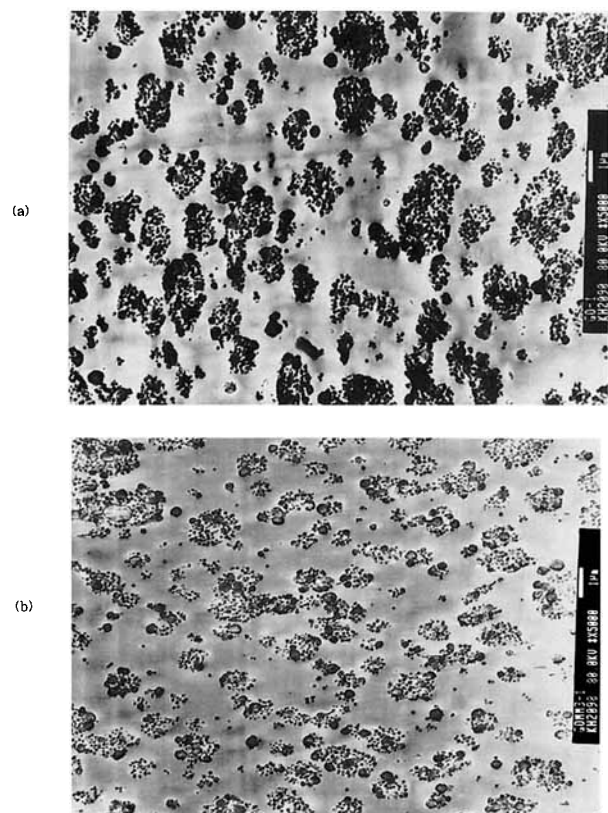


Figure 2 TEM micrographs of PC/ABS blends: (a) MM0; (b) MM3.

Table III Mechanical Properties of Blends

	Tensile Strength at Yield (N/mm ²)	Elongation at Break (%)	Izod Impact Strength (kg cm/cm notch)
MM0	59.2	33.1	11.2
MM3	59.3	38.1	25.3
MM6	59.2	40.5	23.1
MM0T	60.2	5.8	1.6
MM3T	66.4	28.6	9.2
MM6T	62.0	37.4	7.2

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