



CHAPTER I INTRODUCTION

Blending of polymers is an excellent way for developing new materials with improved properties. Most polymers are incompatible and various morphologies can be realized via melt processing, for instance droplets or fibers in a matrix as well as stratified or co-continuous structures. The structures induced are usually thermodynamically unstable, and the mechanical properties of the blends are poor because of poor adhesion between the phases.

Nylon (Ny) and polyethylene (PE) blends are thermodynamically immiscible and mechanically incompatible; however a compatible blend of the two components would possess interesting properties based on the complementary behavior of the individual components. A good example is food packaging, due to the good oxygen barrier, very high strength, and high heat resistance of the Ny and the excellent moisture barrier, good flexibility, ease of processing of the PE. The morphology and the properties of the immiscible blends can be enhanced by adding a third component, an interfacially active polymer, called a compatibilizer, which promotes physical and/or chemical interactions between the components. The compatibilizer will typically either be a chemically modified ethylene homopolymer, i.e. via post-polymerization maleic anhydride grafting, or an ethylene copolymer, i.e. an ethylene-acrylic acid copolymer.

The functionalization of polyethylene with a small amount of ionic groups is a particularly attractive way of compatibilizing nylon with polyethylene because the amide groups may interact with the ionic groups via hydrogen bonding, ion-dipole interactions or/and metal-ion coordination during melt blending. The introduction of such specific interactions can improve compatibility and may promote miscibility of polyamide and polyethylene blend. Further, compatibility of Ny and PE blends has also been attributed to amidation reaction occurring between the terminal end groups of Ny and the carboxylic acid groups. Copolymers of ethylene with monomers containing acid groups are important commercial products. These materials are sold commercially with either hydrogen as the neutralizing agent for the acid group, or with a metal cation as the neutralizing agent. The latter are termed ionomers, and

typically the amount of acid groups neutralized with a metal cation is less than stoichiometric. One common commercial type of ionomers is a copolymer of ethylene and methacrylic acid marketed by DuPont under the trademark Na-EMAA. The two most common neutralizing cations are zinc (Zn^{2+}) or sodium (Na^+). The properties of zinc-neutralized and sodium-neutralized carboxylate ionomers are very different, such as sodium ionomers absorb significantly more water and tend to have higher fractional crystallinities than zinc ionomers.

Zinc-neutralized ionomers have been studied as blend compatibilizers extensively. The impact resistance, tensile properties, and barrier properties of Ny and PE blends showed marked improvement with the addition of compatibilizer. Thermal stability of Ny6 and PE blend observed by TGA technique can be improved by adding of acrylic acid onto PE, and the crystallization behavior of this blend were also observed by WAXS. The Ny6 or LDPE crystallize into spherulites with dimension smaller than those of the corresponding neat polymers and crystallization temperature dramatically shifted toward lower temperatures. In this present work, blends of nylon 6 and low-density polyethylene (LDPE), using sodium-neutralized copolymers of ethylene and methacrylic acid (Na-EMAA) as a compatibilizer, were produced. Blends of Ny6 and Na-EMAA, as well as Na-EMAA and LDPE, were also investigated. Attention was focused on the thermal behavior, crystalline structure, and phase morphology of these blends as a function of the compatibilizer content, and the effect of EMMA with different type of neutralizing metal ions on Ny6/LDPE blends were also investigated.