CHAPTER I

INTRODUCTION

Materials and their development are fundamental to world of technology. The nanoscale and associated nanoscience and technology afford unique opportunities to create revolutionary material combinations. These new materials circumvent classic material performance trade-offs by accessing new properties and exploiting unique synergism between materials. The reinforcement of polymers using fillers, whether inorganic or organic, is common in the production of modern plastics. Polymeric nanocomposites (PNCs) (or polymer nanostructured materials) represent a radical alternative to conventional-filled polymers or polymer blends. In contrast to the conventional systems where the reinforcement is on the order of microns, discrete constituents is on the order of a few nanometers [1] and the most popular nanometer filler used "Montmorillonite".

Montmorillonite is the most familiar species of smectite group [2] which usually consists of two fused silica tetrahedral (T) sheet sandwiching an edge-shared octahedral (O) sheet of either magnesium or aluminium hydroxide. Parallel TOT layers are packed one above the other and the exchangeable hydrated cations are located between the layers. The individual platelet thickness is just one nanometer but surface dimensions are generally 300 to more than 600 nanometers. Resulting in a usually high aspect ratio makes nanofiller superior to all other conventional layered filler or short glass fiber. The very low particle size and high aspect ratio yield an extraordinary improvement of the properties in a wide variety of polymer materials. This improvement of the properties may be reached with a very low concentration of nanofiller [3]. Naturally occurring montmorillonite is hydrophilic. Since polymer is generally organophilic, unmodified nanoclay disperses in polymer with great difficulty. Through clay surface modification by cation exchange reaction with organic cation such as alkyl ammonium ions, montmorillonite trends to be more organophilic and therefore, compatible with conventional organic polymer. Moreover the spacing between the silica layers would be increase which an exfoliated silicate layer great disperse in polymer matrix.

However, the uncompatibity of two components, nanoclay and polymer matrix, is often found. Many researches have been investigated to improve this property such as modification the nanoclay with various organic cation with suitable/compatible functional group of used polymer matrix, using compatiblizer, using swelling agent with or without co-swelling agent ,using ultrasonic power or /and selection the suitable method of each polymer matrix type.[4-18]

The organically modified clay can then be intercalated with polymer by several routes. First, solution processing involves dispersion of both the organically modified clay and the polymer in a common solvent. Variations on this process include emulsion or suspension polymerization. Second, in situ polymerization intercalates monomer directly into the organically modified clay galleries, and the monomer can adsorb onto the layer surface. Third, melt intercalation involves mixing the clay and polymer melt, with and without shear in twin screw. [19]

This research aims to prepare the poly (ethylene terephthalate)/montmorillonite nanocomposite films with high strength and good optical property via solution technique using ultrasonic power to promote the compatibility and dispersion of the montmorillonite in the PET solution. PET was used as the polymer matrix of nanocomposite because of its widely used and good performance [20-21]. Generally, the melt blending was the most popular method to prepare the polymer nanocomposites, such as polypropylene [5], polyethylene [10,12], nylon [16], or PET [8,22]. However, due to the limitation of compatibility and/or dispersion of clay in the PET matrix [9-10,13] and the relatively high melting or processing temperature of PET (T_m: 280 °C) compared to the other polymers such as polypropylene (T_m: 100 °C), this research proposed to use the solution technique and ultrasonic power to prepare the nanocomposite. The objectives were to lower the processing temperature and to investigate the possibility to find alternative route to produce the nanocomposite with better dispersion and consequently properties. The 50/50 v/v of 1,1,2,2 tetrachloroethane and phenol was used as mixed solvent and two types of montmorillonite: as received-MMT and 2C18-MMT were studied. Nanocomposite films were prepared by casting method using an auto film applicator with film thickness range of 20-30 micron. The effects of type and amount of montmorillonite on physical, mechanical, thermal, and optical properties of nanocomposite films were investigated.