CHAPTER I
INTRODUCTION

Nanotechnology is one of the key technologies of this century and nanoparticles inorganic filler have been intensively studied such as Si, Al, Ti and Zn. In this work, we will concentrate on Titanium (Ti), this element is finding more and more applications in today's society. Over 90% of the worldwide use of titanium is in the oxide form, TiO_2 (Titanium Dioxide), thus creating a high demand. TiO_2 is commercially available in two crystal forms: rutile and anatase (Figure 1), rutile phase is in thermodynamically stable state while anatase phase is in metastable state. Rutile has higher refractive index and exhibits superior weather resistance whereas many studies have confirmed that the anatase phase of titania is the superior photocatalytic materials for air and water purification, water disinfection and hazardous waste remediation.

Rutile Anatase

Figure 1.1 The crystal structure of rutile and anatase of TiO_2.

Nanometer-sized titanate particles have been intensively studied because of their versatile applications, as shown below.

In pigments, the most important function of TiO_2 is in powder form as a pigment for providing whiteness and opacity to products such as paints and coatings, plastics, paper, printing inks, fibers, cosmetics and sunscreen. Titania is very white and has a high refractive index that determines the opacity, unliked colored pigments that provide opacity by absorbing visible light, titanium dioxide provide opacity by scattering light, the white pigment can bend light. If there is enough pigment in

system, all light striking the surface will be scattered outward, and the system will appear opaque and white.

Many studies have been published on the use of nanometer TiO_2 as a photocalalyst to purify water and air, to degrade the organic pollutants and to kill bacteria. Photocatalytic activity is the ability of a material to create an electron hole pair as a result of exposure to ultraviolet radiation. The resulting free-radicals are very efficient oxidizers of organic matter (Figure 2). Photocatalyst systems in TiO_2 have been extensively studied because of its potential use in sterilization, sanitation and remediation applications. The photocatalysis activity of titania results in thin coatings of the material exhibiting self cleaning and anti-bacterial properties under exposure to UV radiation, TiO_2 offers two unique properties 1. strong oxidation power that can be used to kill bacteria attack on the wall, or oxide/remove foul smell (e.g. TiO_2-coated tile and TiO_2 coated glass are commercially available) 2. super hydrophobicity property can allow dirt and stain to be easily washed away with water.

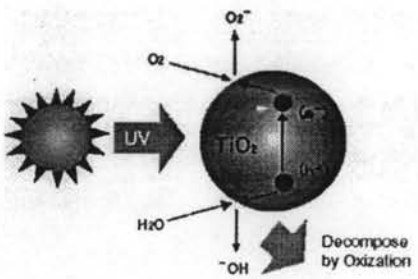

Figure 1.2 The absorption and decomposition mechanism of organic pollutants.

Addition of nanoscale inorganic oxides lead to increase the ionic conductivity and cation transference number of polymer and also affect the optical properties of nanocomposites such as refractive index. With "little effect" and "surface effect" the nanoparticle has many special properties that are different from those of other larger particles because smaller particles have larger surface area per gram or per volume ratio and therefore can be more reactive. Modification of the polymer with inorganic nanoparticles results in polymer/inorganic nanoparticle composites with excellent performance due to the combination of higher hardness, durability and thermal stability of the inorganic filler and the good flexibility,

toughness and processability of the polymer. Nanoparticle filled polymers exhibit enhanced mechanical, thermal, electrical, optical, and barrier properties at rather low nanoparticle loadings compared to traditional composites. However, in the process of preparation, there are the great number of factors affecting the properties of the resultant polymer/inorganic nanoparticle composites. The main factors are the nanoparticle size and volume (or weight) fraction, the nature of the matrix and its adhesion to the nanoparticle, the nanoparticle dispersing into the matrix, and manufacturing technology. Among these factors, the interfacial adhesion and dispersing are of cardinal importance and markedly influence the properties of nanoparticle-filled polymers.

In this present work, attemps to "disperse" nanocomposite of TiO_2 particles in polymer matrix using master batch manufacturing process were carried out. Isotactic Polypropylene (PP) was chosen as a polymer matrix. It is a commodity plastic, cheap, good strength and good processibility. Attentions were focused on crystallization, crystalline structure, thermal stability, mechanical porperties and morphology of the obtained composites.