

CHAPTER 1

INTRODUCTION

1.1 Overview

Nowadays, thin films are important materials which are used in several industries. They are extensively used for various functions in microelectronics, Micro Electro Mechanical System (MEMS), biomedical coatings, storage mediums, Silicon-based semi-conductor devices, industrial coatings, optical coatings, nanotechnology and ceramics.

Electronic semiconductor devices and optical coatings are the main applications of thin films. Moreover, high-absorbing p-type semiconductor and transparent conducting oxide (TCO) films are used in solar cell technology. The important thin films have been developed using semiconductor materials such as amorphous silicon, copper indium diselenide (CuInSe_2), cadmium telluride (CdTe), indium tin oxide (ITO) and Zinc Oxide (ZnO).

ZnO is a material which is the important II-VI compound semiconductor due to its direct energy gap and large excitation binding energy at room temperature. It has unique optical and electrical properties which can be used in a variety of applications, such as a high transmittance conductive oxide coating for solar cells [1], gas sensors [2,3], UV photodetectors [3], bulk acoustic wave resonators [4], and photocatalyst [5].

Some semiconductors, such as TiO_2 [6] and ZnO [5], are used as photocatalytic degradation of organic pollutants in water and air. A photocatalytic process is based on the generation of electron-hole pair that can give rise to reactions by the substance adsorbed on the surface of the photocatalysts. In order to

improve photocatalytic efficiency, it has been demonstrated that by increasing the separation between coupling two semiconductors, it can slow the recombination of electron hole pair and extend the energy range of photoexcitation. Therefore, many coupled semiconductor systems, such as ZnO-SnO₂ [7] TiO₂-ZnFe₂O₄ [8] ZnO-TiO₂ [9,10], and some noble metals, such as Fe-TiO₂ [11] and Ag-TiO₂ [12], were coated on the surface of semiconductor to trap the charge carrier.

1.2 Objective of this work

In this study, attention is given to the fabrication and characterization of ZnO and ZnO-TiO₂ composited nanoparticles and thin films prepared by sparking process. Because of that sparking process is a novel method for preparing thin films, the understanding of mechanism and effect of setting up parameters such as voltage and the tip shape on size of the particles should be firstly concentrated.

ZnO is well known in terms of various functionalities, the prepared films were tasted via various properties investigation such as, electroconductivity and optical transparent (for used the films as transparent conducting oxide) and UV filter and the rectifier contact (for possibility of light emitting devices). TiO₂ is one of the most popular photocatalysts for the photodegradation of organic pollutants due to its high photocatalytic activity, excellent stability for chemical and photocorrosions. Moreover, the sparking process gives the opportunity for produced coupled semiconductor thin films. In this thesis, ZnO-TiO₂ coupled nanoparticle was considered due to its photocatalytic properties.