CHAPTER I
INTRODUCTION

Semiconductor photocatalysis is a promising technology in air purification, water disinfection, hazardous waste remediation, and water purification. Several semiconductors have sufficient band gap energies for promoting or catalyzing a wide range of chemical reactions of environmental interest. Among various candidates, titanium dioxide (TiO_2) is proved to be the most suitable catalyst for widespread environmental applications because of its biological and chemical properties and cost-effectiveness (Deng *et al*, 2009)

Titanium dioxide nanotubes (TNTs) are considered as an ideal substrate for semiconductor photocatalysis, electrochemical sensors, and dye-sensitized solar cells. However, as well known, TiO_2 is a wide band gap semiconductor (Eg = 3.2 eV for anatase phase) that can only be excited by ultraviolet radiation, accounting for only a small fraction (≈5%) of the sun's energy, as compared to the visible light (≈45%). Another major limiting factor is the high recombination rate of the photogenerated electron–hole pairs. Therefore, it is of great importance for the TNTs to extend its ability to harvest solar energy into the visible part of the spectrum and to promote the separation of the photogenerated carriers. Doping with transition metal ion has been attempted to improve its performances (Choi *et al.*, 1994). Some investigators reported that the doping of TNTs with Cr significantly enhanced the photocatalytic activity for the photodegradation of p-nitroaniline (Zhang *et al.*, 2008). Hsieh *et al.* (2009) prepared highly porous Co-Doped TNTs for enhancement of adsorption and photocatalytic activity. Alam *et al.* (2009) reported that the doping of TNTs with Ru significantly enhanced the photocatalytic activity for the photodegradation of methylene blue. Kim *et al.* (2009) prepared Ni-doped TNTs by the simple and effective hydrothermal treatment. Recently, Hussain *et al.* (2011) reported that Fe (III) and Cr (III)-doped TNTs exhibited much higher photocatalytic activity than undoped TNTs.

In this work, modification of TNTs by doping with metal via hydrothermal method was investigated to improve the photocatalytic activity and to compare their results. The products were characterized using various techniques.