CHAPTER I
INTRODUCTION

Heterogeneous photocatalysis can be considered as one of the 'advanced oxidation technologies' (AOT) for air and waste water treatment (Herrmann, 1999). It uses a semiconductor together with photon. There are a lot of research works studying photocatalysis because this technique does not produce toxic materials like the chlorination technique and does not need high temperature for operation. The difference with the conventional catalysis is the mode of catalyst activation. The conventional method requires heat while the photocatalysis needs light (Herrmann, 1999).

When a semiconductor is activated by light with an appropriate wavelength, it generates reactive free radicals, which contribute to oxidation degradation of non-biodegradable organic compounds to take place. It is this radical that converts most organic materials to carbon dioxide, water and inorganic ions. In general, TiO_2 is widely used as a photocatalyst because of its good optical and electronic properties, non-toxicity, chemical stability (corrosion resistance), and low cost (Litter, 1999). Moreover, there is no need for strong oxidizing agents such as O_3 or H_2O_2 because of its good characteristics in powerful oxidation strength (Tsai and Cheng, 1997). Naturally, TiO_2 has three phases (anatase, rutile, and brookite). It has been found that the anatase form is more photocatalytically active than the rutile form. The activity of TiO_2 depends on its crystal structure, specific surface area, particle size distribution, pore structure, and the ratio between anatase and rutile phases, which could be related to its thermal stability (Yoo *et al.*, 2005, Bakardjieva *et al.*, 2005).

Most previous works involve synthesis of TiO_2 from many methods such as microemulsion (Hong *et al.*, 2003), micro mixing (Chen *et al.*, 2004), chemical vapor deposition (Jung *et al.*, 2005), and conventional sol-gel methods (Tharathonpisuttikul, 2001, Moonsiri *et al.*, 2004, Thangsatjatham, 2004). Electrospinning has emerged as an alternative to the above methods for TiO_2 synthesis (Wattanaarun *et al.*, 2005). The technique is a process by which high static voltages are used to produce an interconnected membrane like web of small fibers, with the fiber diameter in the range of 50-1000 nm (Viswanathamurthi *et al.*, 2004).

Titania nanofibers have also been prepared by the combination of sol-gel and electrospinning methods (Watthanaarun *et al.*, 2005). Amorphous titania nanofibers have been electrospun from titanium isoproproxide mixed with acetic acid and high molecularweight polyvinylpyrrolidone (PVP) to form TiO_2/PVP composite materials (Madhugiri *et al.*, 2004, Watthanaarun *et al.*, 2005). The pre-calcined fibers have shown the pure anatase form. For thermal stability improvement of post-calcined fibers, a secondary metal doping was used into the precursor solution. It was found that silicon doping can enhance the thermal stability after the calcination (Watthanaarun *et al.*, 2005).

In this work, preparation of TiO_2 in the form of nano to sub-micron fibers by the electrospinning method and its efficiency for photocatalytic degradation of 4-chlorophenol (4-CP) was studied. Titania nanofibers were tested in a batch reactor.