

**UNIVERSITI TEKNOLOGI MARA**

**PHOTOCATALYTIC ACTIVITY OF  
ENCAPSULATED Ag:TiO<sub>2</sub> POWDER  
IN Ag:TiO<sub>2</sub>/PVA NANOFIBERS  
LAYERS**

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Thesis is submitted in fulfilment  
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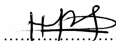
## AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work. Unless otherwise indicated or acknowledged as reference work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, Regulating the conduct of my study and research.

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## ABSTRACT

TiO<sub>2</sub> powder is a precious photocatalyst material which is widely used as cleansing agent especially for waste water treatment. Silver doping was carried out to increase the efficiency of the TiO<sub>2</sub>. For easy removal and multi-cycle used, the encapsulated Ag:TiO<sub>2</sub> powder in Ag:TiO<sub>2</sub>/PVA nanofibers layers was successfully prepared via sol gel and electrospinning techniques by immobilize Ag doped TiO<sub>2</sub> powder on the nanofibers and encapsulated in the layers between nanofibers. The optimum concentration of Ag dopant is based on its photocatalytic activity which varied from different annealing temperature and different Ag content. All the samples were tested under UV and Solar irradiations. From the Photocatalytic result of pure TiO<sub>2</sub> with different annealing temperature, it was found that temperature which have mixed phase of anatase and rutile was shown best performance compare to anatase to rutile phase alone. Moreover, for doping TiO<sub>2</sub> with different Ag concentration, it was found that, 0.5wt% Ag doped TiO<sub>2</sub> powder heated at 750°C showed to be the most effective proportion as photocatalyst with ratio of anatase to rutile is 75:25. FTIR results showed that, peak at 546cm<sup>-1</sup> was assigned to the stretching vibration mode of Ti-O-Ti bond. After making detail analysis on FTIR band, 0.5wt% Ag doped TiO<sub>2</sub> powder has IR band at 3410cm<sup>-1</sup> and 1642cm<sup>-1</sup> which capable to increase the photocatalytic activity by providing more hydroxyl radical during degradation activity. The average diameter of Ag doped is 600 nm -700 nm. The crystallite size for anatase and rutile for encapsulated Ag:TiO<sub>2</sub> powder in Ag:TiO<sub>2</sub>/PVA nanofibers layers is 39.1nm and 61.95nm, respectively. Encapsulated Ag:TiO<sub>2</sub> powder in Ag:TiO<sub>2</sub>/PVA nanofibers layers succeeded to degrade the methyl orange (MO) solution within 150 minutes when expose to the UV light with  $k_{app}$  value and  $k_r$  value is  $33.4 \times 10^{-3} \text{min}^{-1}$  and  $0.1952 \text{mmol}^{-1} \text{min}^{-1}$ , respectively. Additionally, the performance test was conducted on the encapsulated Ag:TiO<sub>2</sub> powder in Ag:TiO<sub>2</sub>/PVA nanofibers layers for its recycle and reuse capability. It was found that the sample can be reused to at least five complete cycles with almost consistent rate of degradation. The new finding is on the structural of the encapsulated Ag:TiO<sub>2</sub> powder in Ag:TiO<sub>2</sub>/PVA nanofibers layers in which it can reuse for several times with consistent performance and directly give opportunity for cost saving.

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# CHAPTER ONE

## INTRODUCTION

### 1.1 GENERAL OVERVIEW

Malaysia is a country that is active in exporting textile and clothes industry around the world beside Bangladesh, Japan, India and others[1]. This industry promises high income to the country. Unfortunately, this industry discharged some contaminations to environment especially in irrigation area such as river, ground water and seawater because water was used as a medium to dissolve dye for laundry colouring[1]. Several kinds of contaminations or toxic metal were determined in polluted water such as 2-[2-acetyl-amino)-4-[bis(2-methoxyethyl)amino -5-methoxyphenyl]-5-amino-7-bromo-4-chloro-2-H-benzotriazole (PBTA-1), sulphates, iron, chromium and other colour point[1]. In addition, mixture of the various colours from dye interfere water to absorb light from Solar and thus disturb the photosynthesis reaction of aquatic plants. Therefore, many efforts have been done to cure this polluted water.

Besides that, Cameron Highland in Malaysia is one of the largest suppliers of many organic food resources because of its cool environment which is suitable for planting many kind of plants such as vegetables and fruits. However, Cameron Highland is recently facing water pollution due to the discharge of waste and fertilizer of plant to the water because of its wide area of agriculture activity. Due to wide development of land activity for planting the vegetables and fruit, heavy flood has occurred which caused the polluted water spread over the place and harmful to citizen. *E. coli* bacteria pollution was widely detected in this area which can cause human health problem [2]. However, human need clean water for drinking, bathing, cooking and others to stay healthy. Contamination present in water from industrial discharge may be harmful to the surrounding especially to aquatic living organisms. Several disease caused by lack of clean drinking water has been found. For example, the high concentration of iron presence in drinking water cause liver disease (hemosiderasis)[3] and high concentration of Sulphate in water lead to malfunctioning of alimentary canal[1].