UNIVERSITI TEKNOLOGI MARA

SYNTHESIS OF GOLD NANOPARTICLES ON CARBON NANOTUBES/ANODIZED ALUMINIUM OXIDE FOR CATALYTIC REDUCTION OF *P*-NITROPHENOL

FARAH WAHIDA BINTI AHMAD ZULKIFLI

Thesis submitted in fulfilment
of the requirements for the degree of
Master of Science
(Applied Chemistry)

Faculty of Applied Science

July 2019

ABSTRACT

Gold nanoparticles (Au NPs) have been widely used in various applications specifically in the field of catalysis. Au supported catalyst are more favoured over the homogeneous one since it gives superior features such as simplicity in recovery and regeneration. In this research, Au NPs supported on functionalized carbon nanotubes (Au-fCNT) catalysts were successfully synthesized via deposition-precipitation (DP) as this method was a more efficient and simpler approach. However, the limitation of Au-fCNT catalysts in terms of practicality and recovery since Au-fCNT was presented in the powder form creates a new avenue to obtain free-standing catalytic membrane. Au NPs were utilized onto the combination of fCNTs and porous membrane support which is anodized aluminium oxide (AAO) membranes. AAO membranes help in reducing the restacking-induced surface area loss of fCNTs and gave homogeneous distributions of Au NPs. The free-standing catalytic membrane was synthesized through the fabrication of multi-layered assemblies fCNTs decorated with Au NPs on AAO membranes (Au-fCNTs-AAO) by an unsophisticated technique. The AAO membrane was coated with fCNTs by spin coating technique and decorated with Au NPs by an immersion method. Several parameters including the effect of pH, concentration, the voltage applied, and deposition time were studied to obtain an optimum condition in synthesizing Au-fCNT and Au-fCNTs-AAO. These catalysts were characterized by atomic absorption spectroscopy (AAS), Brunauer-Emmett-Teller (BET), Fourier transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), and field emission scanning electron microscope (FESEM), and transmission electron microscopy (TEM) to investigate the structure and morphology of these catalysts. The catalytic activities in the reduction of *p*-nitrophenol (*p*-NP) to *p*-aminophenol (*p*-AP) of Au-fCNT and Au-fCNTs-AAO catalysts were monitored using UV-Visible Spectrophotometer (UV-Vis). The Au-fCNTs-AAO exhibited superior and excellent catalytic activity compared to Au-fCNT in which the *k*-values were 0.678 min^{-1} and 0.072 min^{-1}, respectively. This study offers cost-efficient route, easy separations, excellent reusability, high stability and catalytic efficiency for the large scale of application.

ACKNOWLEDGEMENT

Firstly, I wish to thank God for giving me the opportunity to embark on my MSc study and for completing this long and challenging journey successfully. My gratitude and thanks go to my supervisor Associate Professor Dr Abdul Mutalib Md Jani and my co-supervisor Madam Hanani Yazid for their willingness and kindness to give advice and suggestions to me to complete this research.

My appreciation goes to all staff and lab assistants from UiTM and USM who have provided the facilities and assistance during sampling and testify. Special thanks to my colleagues and friends for helping, teaching and sharing valuable knowledge with me to this project.

I managed to gain a lot of useful knowledge and experiences in the field of chemistry as well as chemical analysis. In completing this project, I am very grateful to have learned many new things during the laboratory works and all sources of information available.

Finally, this thesis is dedicated to the loving memory of my very dear father and mother for the vision and determination to educate me. This piece of victory is dedicated to both of you. Alhamdulillah.

TABLE OF CONTENTS