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**FINAL YEAR PROJECT 2 - THESIS**

# CATALYTIC REDUCTION OF *p*-NITROPHENOL OVER Au-AAO CATALYSTS: EFFECTS OF AAO PORE OPENING AND CATALYST REUSABILITY


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**Final Year Project Proposal Submitted in**
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## ABSTRACT

### CATALYTIC REDUCTION OF *p*-NITROPHENOL OVER Au-AAO CATALYSTS: EFFECTS OF AAO PORE OPENING AND CATALYST REUSABILITY

Anodic aluminium oxide (AAO) supports with varied pore openings were successfully fabricated by electrochemical anodization, exhibiting high porosity with pore size increasing as a function of pore opening time. The highest porosity 32.12% was achieved for the AAO of 90 min opening time. However, prolonged anodization at 120 min (AAO 120) resulted in partial collapse of the hexagonally ordered pore structure of the AAO. Prior to gold (Au) immobilization, all the AAO supports were surface-modified via hydroxyl-silanization. Successful surface functionalization was confirmed by FTIR analysis, evidenced by the shifting of peak at 1558.06 $cm^{-1}$ to 1626.88 $cm^{-1}$ for N-H bending, while 1018.46 $cm^{-1}$ to 1023.97 $cm^{-1}$ for Si-O-Al stretching. The immobilization of Au on the supports of AAO 30, 60, 90 and 120 resulted the Au nanoparticles with sizes below 15 nm, with particularly small Au nanoparticles (<5 nm) observed for AAO 90 and AAO 120. Furthermore, catalytic evaluation in the reduction of *p*-nitrophenol demonstrated that Au-AAO 60 exhibited the highest activity, with a rate constant of 7.66 x $10^{-3}s^{-1}$, corresponding to an average Au particle size of 11.72 nm. In contrast, Au nanoparticles smaller than 5 nm resulted in reduced catalytic activity. Reusability studies showed that Au-AAO 90 maintained good catalytic performance over four consecutive cycles. FESEM analysis after reuse indicated agglomeration of initially <5nm Au nanoparticles, which correlated with the observed decrease in catalytic activity. High catalytic activity is not achieved when the Au particle size is excessively small, indicating that Au particle size plays a more critical role than porosity alone. Although highly porous AAO supports favor the formation of ultra-small Au nanoparticles, this does not necessarily lead to the highest catalytic activity. Instead, these catalysts exhibit moderate activity but maintain good reusability over up to four reaction cycles.

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