Electrochemical Atomic Layer Deposition of Pt nanostructures on fuel cell gas diffusion layer

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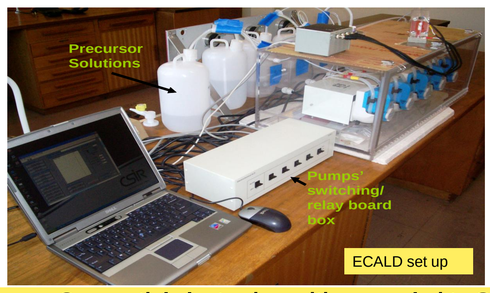
INTRODUCTION

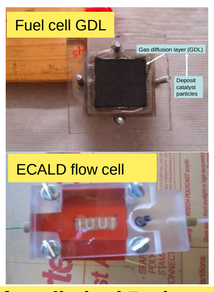
Alternative energy resources are needed to alleviate the energy crisis. Fuel cells are one of the examples to help solve the problem. The main goal of this research is to reduce the cost of fuel cells in order to compete with current market technologies including gasoline internal combustion engines. The membrane electrode assembly (MEA) consists of a membrane, two dispersed catalyst layers, and two gas diffusion layers (GDLs). The electrochemical performance of the fuel cells is strongly influenced by the MEA preparation. Key to successful MEA fabrication is the efficient deposition of catalysts, which must be stable and uniform resulting in high utilization of Pt catalyst. In the assembly of MEAs it is important to achieve good contact between the membrane, the GDL and the catalyst layers. Good contact maximizes catalyst utilization during cell operation[1-3]. Electrochemical Atomic Layer Deposition (ECALD) was identified as a potential MEA fabrication technique to reduce the amount of Pt on the electrode and to increase Pt utilization. EC-ALD is the electrochemical deposition method that involves alternated electrodeposition of atomic layers of elements on a substrate, employing under-potential deposition (UPD) in which one element deposits onto another element at a voltage prior to that necessary to deposit the element onto itself[4,5].

OBJECTIVES

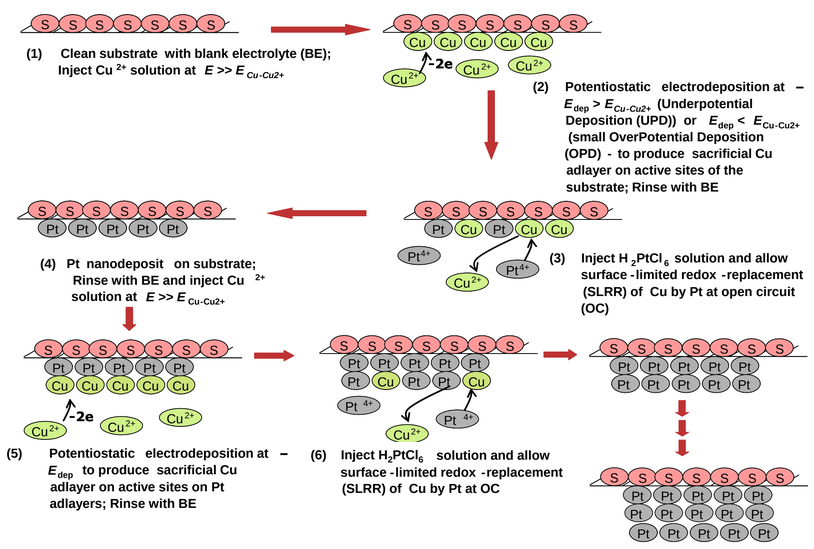
- To deposit Pt nanoparticles on carbon paper (GDL used in fuel cells) using ECALD technique.
- To electrochemically characterize Pt supported on carbon paper towards hydrogen and methanol oxidation as well as CO adsorption in acidic medium
- To observe the morphological structure of Pt on carbon paper utilizing Scanning Electron Microscopy (SEM) coupled to Energy Dispersive X-ray spectroscopy (EDX).

EXPERIMENTAL WORK

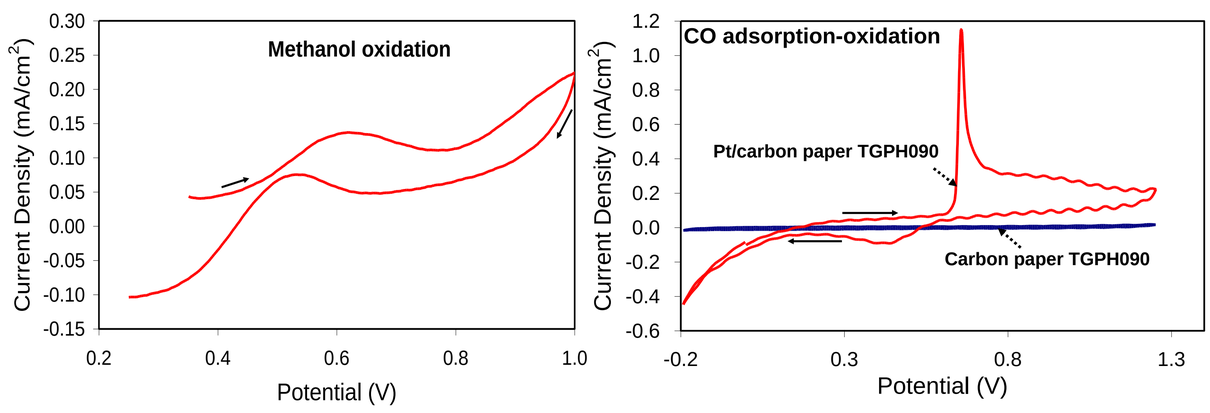




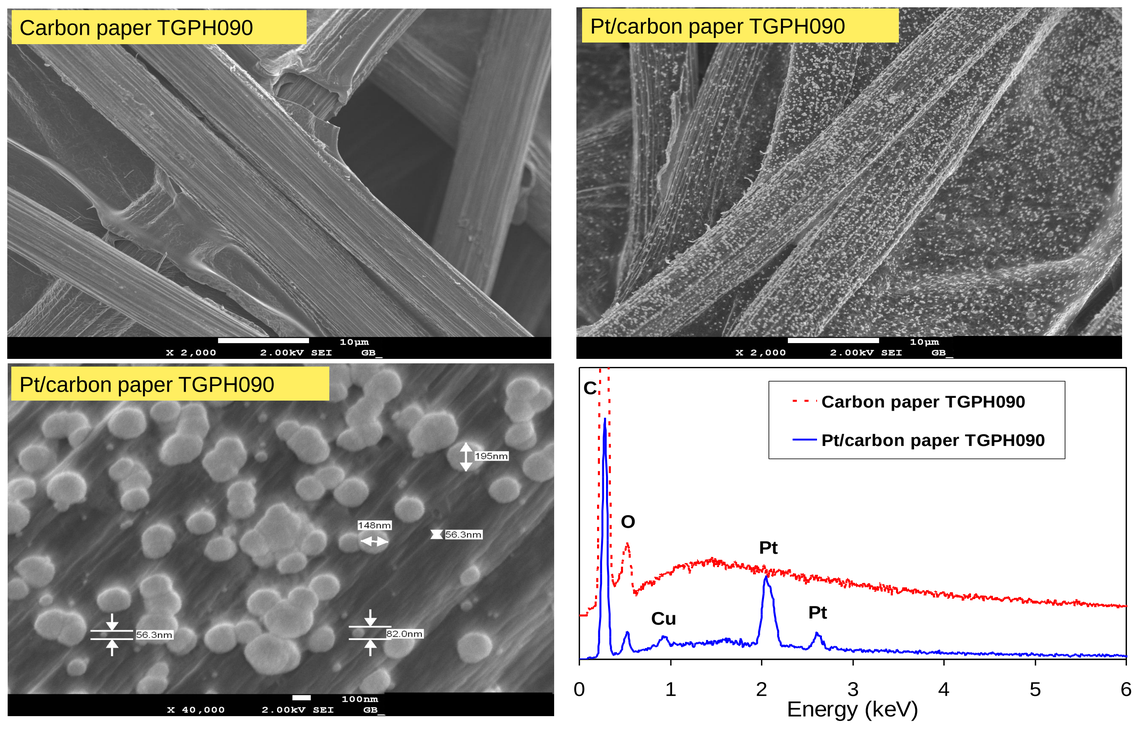
Sequential electrodeposition coupled to Surface-limited Redox-replacement reactions: Synthesis of multilayered Pt electrocatalyst



RESULTS AND DISCUSSIONS



Cyclic voltammograms at 50 mV/s in (i) 0.1 M $HClO_4$ + 0.1 M Methanol and (ii) 0.1 M $HClO_4$ + CO



SEM micrographs and EDX Profile of Pt/carbon paper TGPH090

CONCLUSIONS and FUTURE WORK

- Preliminary results showed that the sequential electrodeposition of Pt on carbon paper was successful.
- Pt and Cu were detected with SEM and confirmed by EDX.
- The sequential electrodeposited Pt on carbon paper showed the electrochemical activity towards hydrogen, methanol and CO adsorption.
- Deposition time will be optimised.
- Carbon paper will be modified with a conductive microporous layer (Carbon black + Nafion ionomer) before the electrodeposition step.
- Fabricate and test MEA's performance in PEMFC.

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