

Electrochemical Study of Pt Deposited Pyrolysed Glucose and Sucrose

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Abstract- Electrochemical properties of carbon prepared by pyrolysis of glucose and sucrose are compared as support for Pt catalyst. The electro catalyst was characterized with scanning electron microscopy and X-ray diffraction. The activity of the electro catalysts for oxygen reduction reaction were studied and compared with commercial Pt/C catalyst.

Index Terms—Pyrolysis, Half Cell Study, Sucrose and Glucose.

I. INTRODUCTION

Carbon has been the subject to several investigations for the past few decades, due to its cost effective synthesis and properties that have been extensively known for its applications in various industries particularly the electrochemical industry as it is of prime importance to industrialize and commercialize many applications like fuel cells^[1]. The use of carbon particles as electrode material, and catalyst support has been widely studied^[2-4].

It is reported in recent literatures that newer synthesis methods of carbon morphologies for more porous nature involves in using soft template method of synthesis rather than the conventional hard template methods^[5-6]. The use of Stober method as investigated by Liu et.al (2011) promises of more economical ways to produce carbon particles of desired morphologies for mass production in more economical alternative methods.

Here a comparative investigation of the half-cell electrochemical properties of 20 wt.% doped Pt on carbon produced by pyrolysed glucose and sucrose are studied under Cyclic Voltammetry (CV), Linear Sweep Voltammetry (LSV) and tested for Methanol Oxidation Reaction (MOR) and oxygen reduction reaction (ORR). The surface analysis was done by SEM and EDAX with XRD to study its crystal structure.

The carbon synthesis follows a novel procedure of impregnating cationic surfactants like CTAB^[8] into the glucose/sucrose mixture along with stabilizers to obtain better surface area, though an investigation of the method was tried by Meng et.al (2005).

II. EXPERIMENTAL

A. Preparation of Carbon from Glucose and Sucrose

Carbon was prepared from Sucrose/Glucose by using it as a precursor solution, where 2.16g of Glucose/Sucrose was added to 30ml of cyclohexane and 1.5ml pentanol. The prepared solution was added to the template molecule solution containing 1g (0.027 mol) CTAB and 0.6g (0.01 mol) Urea with 30ml of water and stirred well for 30 min. The solution was kept in a furnace at 150°C for 18hr.

The obtained particles were washed with acetone and dried at 80°C and kept in a tubular furnace in Nitrogen atmosphere and heated to 800°C for 1hr at a RT of 3.3°C/min.

B. Pt deposition by Polyole process

The obtained carbon particles were well grinded and loaded with 20% Pt by the following process, 50mg of the sample was taken and added with 31.25ml ethylene glycol and sonicated. The mixture was added with 2.32ml of $H_2PtCl_6 \cdot 6H_2O$. The solution is stirred for 3hr and refluxed at 150°C for 6hr and further stirred for 18hr. The particles are filtered and dried for 24hr and grinded.

III. RESULTS AND DISCUSSIONS

The Pt deposited particles were analyzed for its half-cell electrochemical properties under LSV, CV and MOR. The surface analysis of the material was done under SEM imagery and EDAX gave a result of 81.52% presence of C.

The XRD Analysis of the crystal ensures the (111) lattice nature.

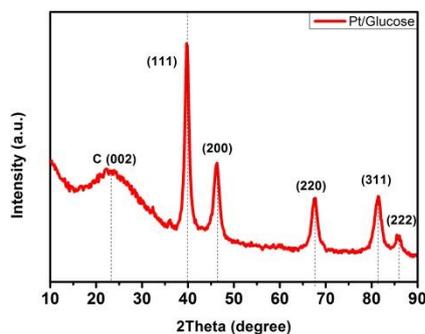


Figure 1: XRD of the Pt/material.

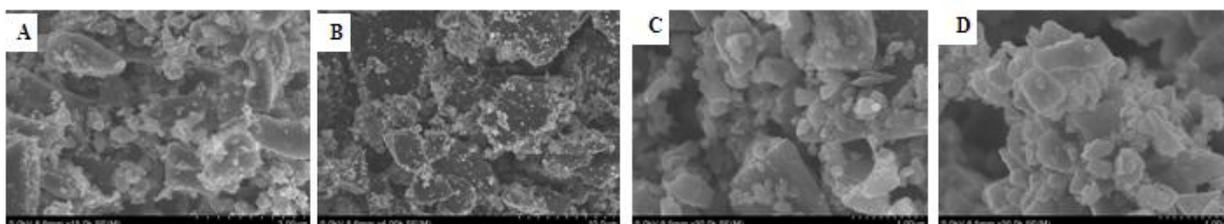


Figure 2: SEM images of: (A) Pt/Sucrose, (B) Pt/Glucose, (C) Undeposited Sucrose, (D) Undeposited glucose

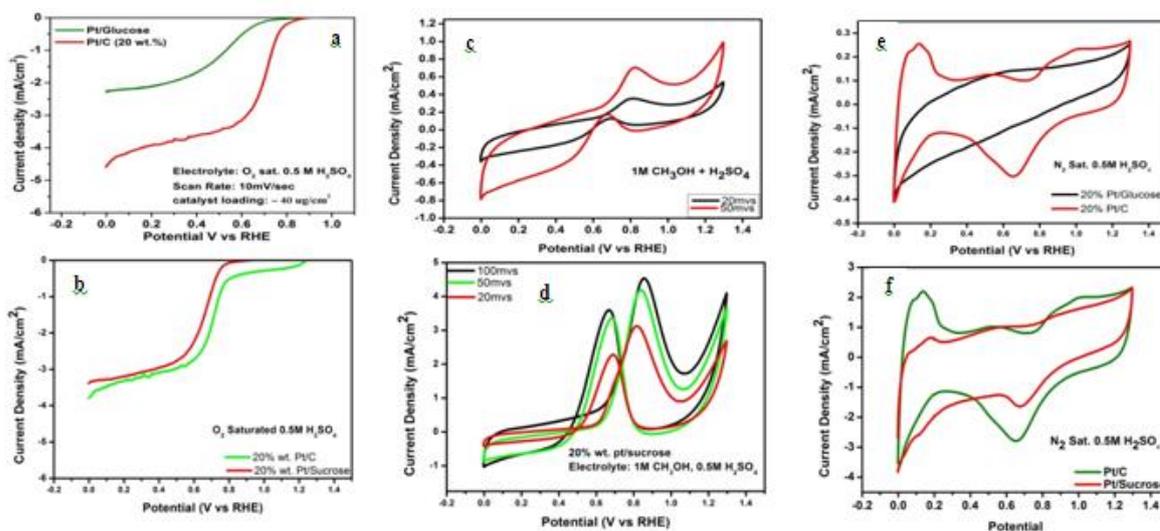


Figure 3: (a) LSV of Pt/Sucrose, (b) LSV of Pt/Glucose, (c) MOR of Pt/Sucrose, (d) MOR of Pt/Glucose, (e) CV of Pt/Glucose, (f) CV of Pt/Sucrose

a. for GCE

For the half cell testing, GCE ink was made by adding 5 μ l of the sample with 0.7ml water, 0.3ml C_2H_5OH and 10 μ l of Nafion solution. It was sonicated and loaded for testing.

b. Preparation of Electrolyte

For the preparation of the electrolyte, 2.72ml of 0.5M of H_2SO_4 with 1M CH_3OH was added and made up to 100ml.

The samples were tested and the obtained results are

tabulated in Figure: 3. It was observed that the samples gave a peak current density of 3.79 mA/cm² with an onset potential of 0.77 V for Pt/Sucrose which is comparable with that of Pt/C.

IV. CONCLUSION.

Here a comparative study of the electrochemical properties of the Pt deposited on sucrose, glucose and Vulcan carbon has been evaluated. From the obtained results of LSV the Pt deposited glucose shows a similar onset potential as that of the Vulcan carbon.

The half cell test results of sucrose and glucose reflects that it shows properties somewhat near to the Vulcan carbon. If it is able to enhance the surface

properties of sucrose and glucose catalyst supports they may exhibit better properties.

From the above work it is evident that sucrose and glucose are promising as a catalyst support for fuel cells.

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