Flexible Binder free electrode for Ultracapacitor

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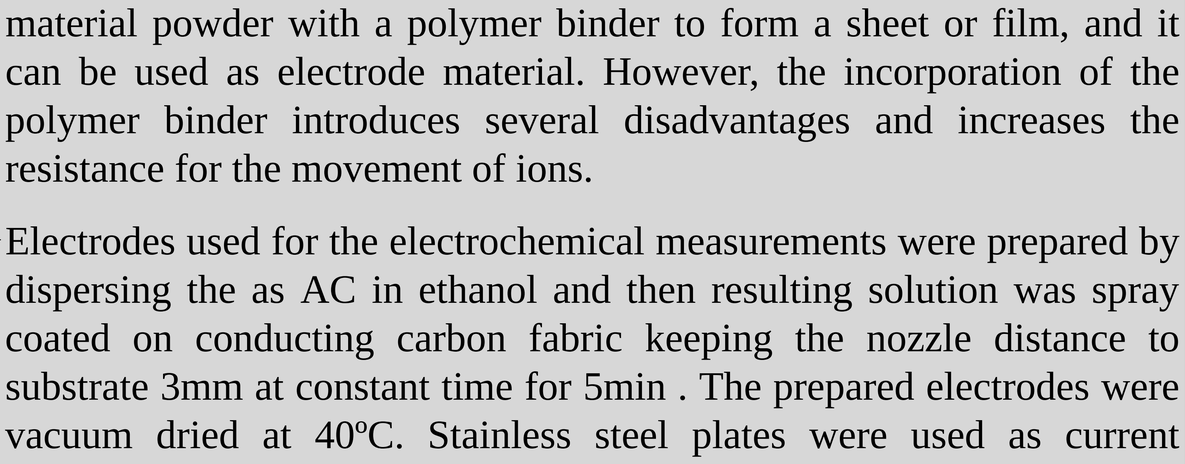
INTRODUCTION

Energy is the basic need required for the human survival and the survival of other countless species on this mother planet. Early human beings used wood as stored energy resource in order to get heat and light. Later as the civilization progresses the human quest of finding more and more energy source dramatically increased in order to fulfill their desire. Over the thousands of years human civilization used the stored energy what is now referred to as fossil fuels. This chemical energy stored within the earth's crust from organic materials which have decayed over many millennia. This chemical energy is able to be converted to other forms of usable energy, including that of electrical energy. But today this primary energy source is under serious extinction. Global warming became an alarming bell for the human society. So one has to think seriously about storing of available energy and retrieving it whenever required. Supercapacitor are receiving remarkable attention as an energy storage device, and being used various applications. Carbon based materials are widely used as electrodes in electrical double-layer capacitor (EDLCs). Supercapacitor performance is basically determined by the structural and electrochemical properties of electrodes. Various types of carbon materials like activated carbon (AC), carbon nanotubes, graphene were used as electrode material for EDLC, out of which activated carbon was found to be the cheapest material.

SYNTHESIS OF ACTIVATED CARBON ELECTRODE

- The traditional electrode fabrication involves the mixing of active material powder with a polymer binder to form a sheet or film, and it can be used as electrode material. However, the incorporation of the polymer binder introduces several disadvantages and increases the resistance for the movement of ions.
- Electrodes used for the electrochemical measurements were prepared by dispersing the as AC in ethanol and then resulting solution was spray coated on conducting carbon fabric keeping the nozzle distance to substrate 3mm at constant time for 5min . The prepared electrodes were vacuum dried at 40ºC. Stainless steel plates were used as current collector, polypropylene as separator and 1M sulphuric acid as electrolyte in the supercapacitor electrode assembly. A symmetric model capacitor was constructed using two AC films as electrode.
- Electrochemical characterizations of the electrode were carried out by cyclic voltammetry (CV), electro-chemical impedance spectroscopy (EIS) and galvanostatic charge-discharge studies. All the electrochemical studies were carried out using an Autolab electrochemical system (ECO Chemie BV, Netherlands). AC impedance measurements were made in the frequency range of 0.01–10^6 Hz.

A SYMMETRIC ULTRACAPACITOR MODEL



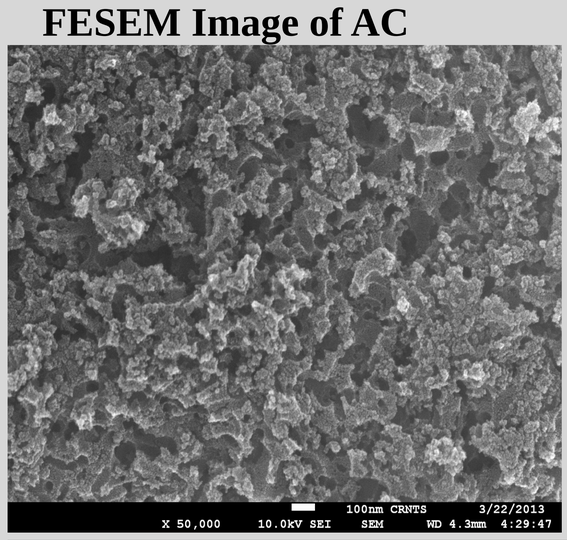
References:

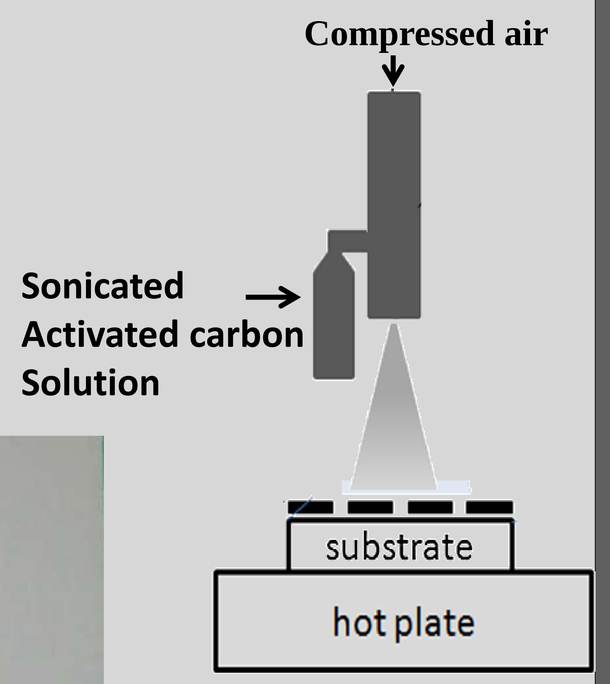
[1] A.K. Shukla, S. Sampath, K. Vijayamohanan, Electrochemical supercapacitors: Energy storage beyond batteries, Current science 79 (2000) 1656-166

[2]. C. Ye, Z. M. Lin, S. Z. Hui, Electrochemical and Capacitance Properties of Rod-Shaped MnO_2 for Supercapacitor, J. Electrochem. Soc. 152 (2005) A1272-A1278.

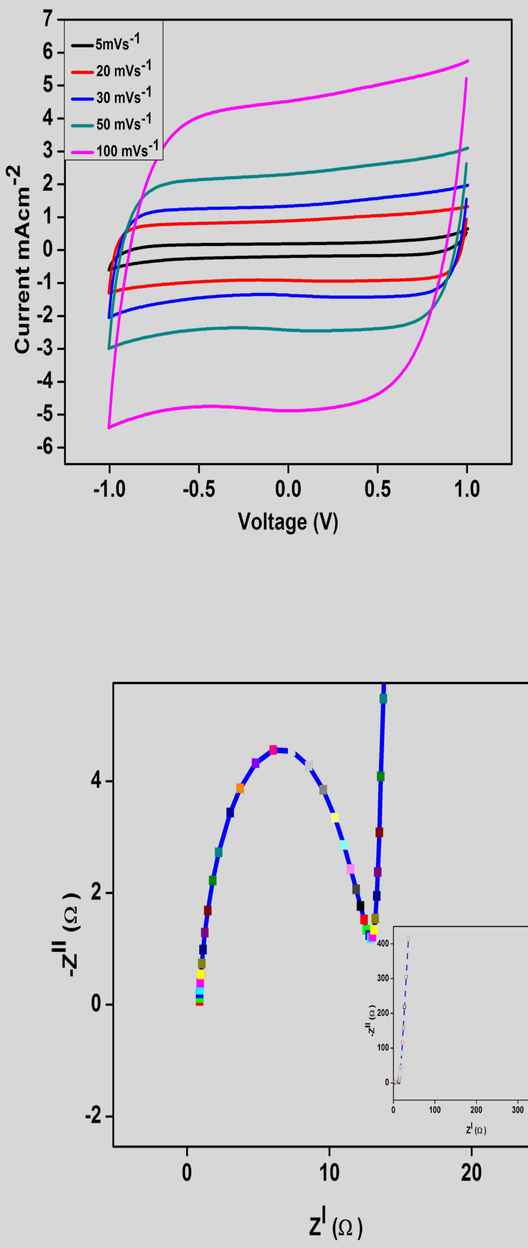
RESULTS AND DISCUSSION

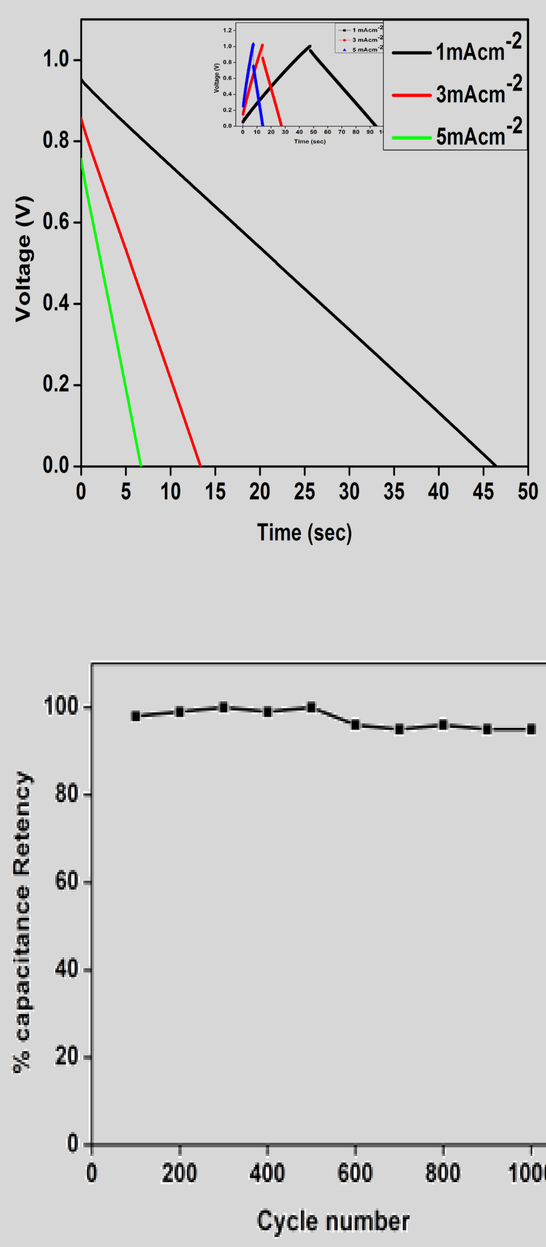
FESEM Image of AC





ELECTROCHEMICAL CHARACTERIZATION





CONCLUSIONS

- A binder free, aqueous symmetric Ultracapacitor has been fabricated.
- A capacitance of 160 F/g at a current density of 1mAcm^{-2} with excellent cycle stability. Activated carbon flexible Ultracapacitor will be a promising energy storage device.

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