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A REVIEW ON RECENT EMERGING ELECTRODE MATERIALS FOR SUPER CAPACITOR ENERGY STORAGE DEVICES

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ABSTRACT

A super capacitor provides high energy density storage than ordinary capacitor.Super capacitor energy storage device fills the void between high energy density battery and the traditional capacitors. It replaces the batteries in some applications, because it can provide high power, rapid charging and long life. In this review paper, a summary of novel material developments in super capacitor and its types using various electrode materials have been reported.

KEYWORDS: Super capacitor, EDLC, Pseudo capacitor, hybrid capacitor

1. INTRODUCTION

Energy and Environment problems are major problems now a day. It induces the electricity generation from natural resources. The renewable energy sources are used to produce electricity. Due to the time gap between supply and demand a energy storage devices are required. Batteries and capacitors are plays a vital role in energy storage devices but it is not provide high energy density storage. This enhances the research on super capacitors because it can provide high power, rapid charging, long life, flexible packaging, less weight and low maintenance. The super capacitors have many applications in industry, automotive industry, high power military applications electric vehicles, digital communication instruments, emergency doors on jet planes, and pulsed lasers. Super capacitors store energy directly through the electrostatic charge accumulated at the electrode/electrolyte interfaces. When super capacitor used with batteries or fuel cells they served as temporary storage devices [1, 2]. The power density of super capacitor is higher but the energy density is lower than chemical sources. The super capacitors life is extraordinary long and much safer than batteries.Owing to the alarming demand of energy for various activities of mankind, a spurt in research related to energy harvesting and energy storage devices is being focused by many scientists. Since electrochemical super capacitors (ESCs) are capable of storing energy, and have high specific power and long term stability; they can be used as energy storage devices in portable electronic gadgets. The excellent property of ESCs is mainly due to the charge storage mechanism that primarily occurs at the solid-liquid interface via electrochemical double layer capacitive (EDLC) and pseudo-capacitive behaviours. EDLC uses the ion adsorption phenomenon whereas the pseudo-capacitor stores energy by fast surface redox reactions. Nano particles used in the electrochemical super capacitor will improve its performance. There is a lack of awareness in this particular area.

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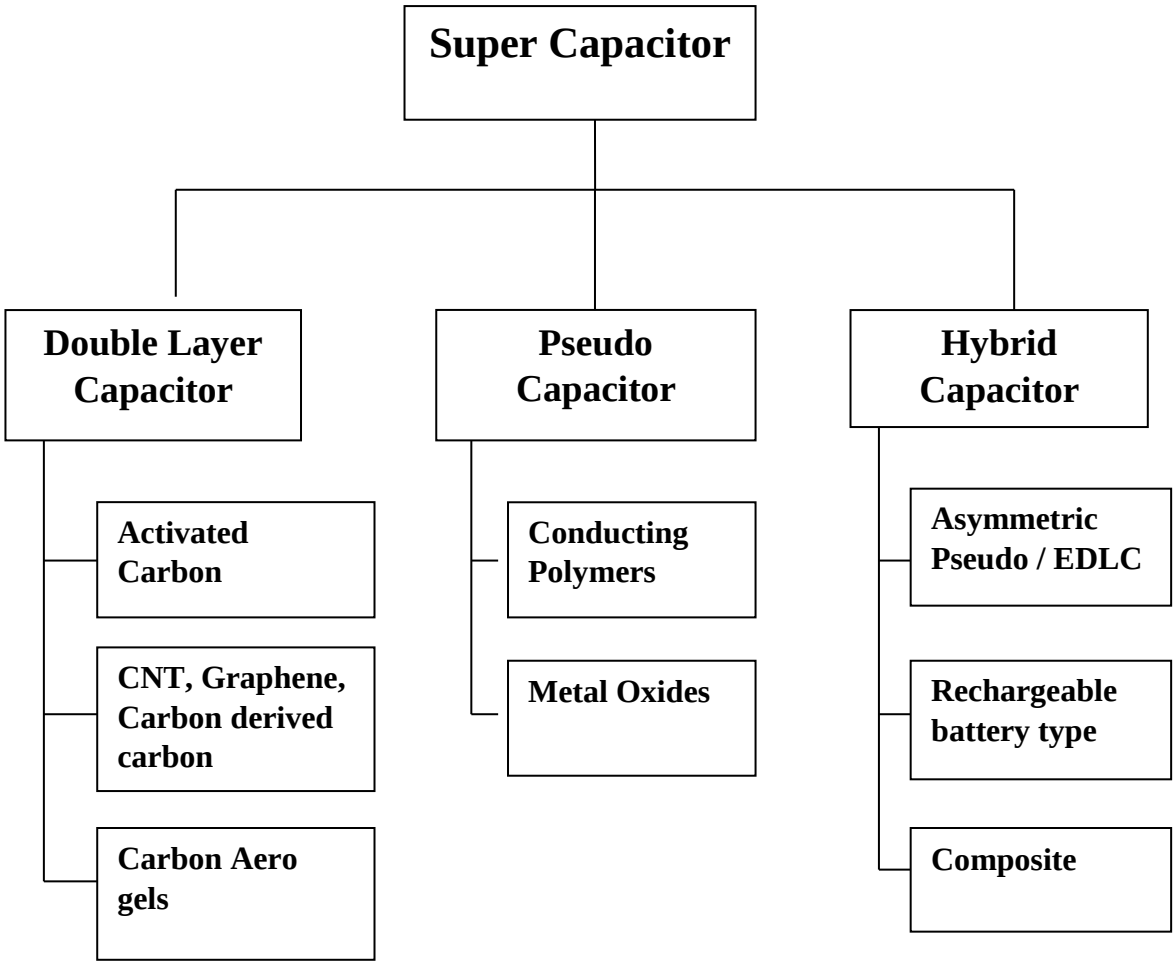
Types of super capacitor



2. ELECTROCHEMICAL DOUBLE LAYER CAPACITORS

Electrochemical Double Layer Capacitors are high density energy storage device compared to batteries. It is based on the electrostatic effects that occur between two carbon electrodes exposed in an electrolyte. A separator is placed between the electrodes. When a voltage is applied to the electrodes the positive electrodes attract the negative ions from electrolyte and the negative electrodes attract the positive ions from the electrolyte. These ions are diffuse into the pores present in the separator. The diffused ions form a new layer over the electrodes. This double layer increases the surface area and reduces the distance between the electrodes. A charge transfer reaction present in batteries allows the energy to be stored and delivered at high power. The maximum capacitance of EDLC devices is on the order of hundreds of farad per gram. It is higher than dielectric capacitor whose capacitance is typically in the microfarad per gram [3]. There are three main types of EDLCs in terms of the carbon.

(i) Activated Carbon
(ii) Carbon Aerogels
(iii) CNT and Graphene

Pseudo Capacitors

Pseudo capacitors store electrical energy faradaically by electron charge transfer between electrode and electrolyte. This is accomplished through electro absorption, reduction-oxidation reactions

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(redox reactions), and intercalation processes, termed pseudo capacitance. These faradaic processes may allow pseudo capacitors to achieve greater capacitances and energy densities than EDLCs [4, 5].

Pseudo capacitors and EDLC joined together to create a capacitor. A Pseudo Capacitor has a chemical reaction at the electrode but in EDLCs the electrical charge storage is stored electro statically with no interaction between the electrode and ions.

The pseudo capacitor is used as
(i) Metal oxides
(ii) Conducting polymers

Hybrid super capacitors
The pseudo capacitors provide better capacitance compare than EDLC but this hybrid capacitor provides the combination of both the energy source. The suitable combination of increases the power densities. Light vehicles using super capacitors are very important role in hybrid and fuel cell vehicles. The hybrid super capacitors have better performance compare than pseudo capacitors and EDLC. It was shown that when one recognizes that the energy stored in the capacitors is less than 1/10 that in the batteries for hybrid applications, the price of super capacitors needs to decrease to about .5- 1 cent Farad for capacitors to be cost competitive with high power batteries at $500-700/kWh (6) .

The hybrid super capacitor is classified as
(i) Asymmetric pseudo / EDLC
(ii) Rechargeable battery
(iii) Composite
(iv)

3. CONCLUSIONS
Super capacitors are highly efficient modules owed to the low equivalent series resistance, even at high currents which means that only a little amount of energy is lost while charging and discharging the super capacitor. Super capacitor is an alternative energy storage device and it has many applications. This novel energy storage device provides high electo chemical property, high power density and good stability.

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