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Ultra Capacitor: Alternative Energy Storage Systems

Ashish Kumar, Kriti Singh, Dr. Debmalya Bhattacharya
Department of Electronics & Communication Engineering
Vel Tech Dr.RR & Dr.SR Technical University, Chennai.

1. ashish.ksinha@yahoo.co.in, 2.kriti.gc.dd.8@gmail.com,3. elec.research@yahoo.com

Abstract: ***Today, ultracapacitors are a viable component for production aim designs in the power electronics world. The need for highly reliable back-up and emergency power are creating significant markets for energy storage and power delivery. Electrical wind turbine pitch systems, uninterruptible power supplies and electronic products such as wireless communication devices and digital cameras are some of the many applications where ultracapacitors have been designed in.***
Ultracapacitors are components which have properties of a complexe capacitor system which is sensitive to voltage, temperature and frequency. The understanding of their behavior is primordial to characterize and operate them.

Keywords- **Ultra capacitor, Energy Storage.**

I.INTRODUCTION

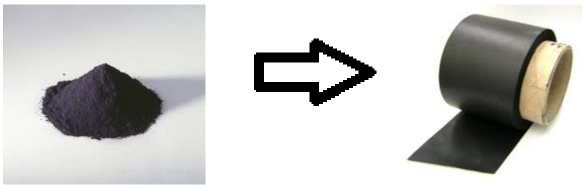
Electrochemical double layer capacitors (EDLCs) are similarly known as Ultracapacitors. An ultracapacitor stores energy electrostatically by polarizing an electrolytic solution. Though it is an electrochemical device there are no chemical reactions involved in its energy storage mechanism. This mechanism is highly reversible, allowing the ultracapacitor to be charged and discharged hundreds of thousands to even millions of times.

Capacitance is defined in the terms of charge storage and is known as farads. Charge storage space is affected mainly due to three basic factors in a capacitor these are plate/electrode area, plate/electrode spacing and the dielectric material used in ultracapacitor.

Electric double-layer capacitors have a variety of commercial applications, especially in "power smoothing" and momentary-load strategy. Some of the earliest uses were motor establishment of capacitors for large engines in tanks and submarines, and as the cost has fallen they have started to appear on diesel trucks and railroad locomotives. In recent times, it is becoming a topic of some interest in the green energy world, where their ability to store energy quickly makes them particularly suitable for regenerative braking applications, whereas batteries have difficulty in this application due to slow charging rates. New technology in development could potentially make Electrochemical double layer capacitors, EDLCs with high adequate energy density to be an attractive replacement for batteries in all-electric cars and plug-in hybrids, as EDLCs are quick charging and exhibit temperature stability. They can also be used in PC Cards, spark photography devices in digital cameras, portable media players, and in automated meter reading

II.CONSTRUCTION

The specifics of ultracapacitor construction are dependent on its application and uses of ultracapacitor. The materials may differ slightly from manufacturer design or due to specific application needs. The cohesion among all ultracapacitors is that they consist of a positive electrode, a negative electrode, a separator between these two electrodes i.e. dielectric, and an electrolyte filling the porosities of the two electrodes and separator.



ACTIVATED CARBON FABRICATION POWDER ELECTRODE

The assembly of the ultracapacitors can vary from product to product. This is due in part to the geometry of the ultracapacitor packaging. For products having a prismatic or square packaging arrangement, the internal construction is based upon a stacking assembly arrangement with internal collector paddles extruding from each electrode stack. These current collector paddles are then welded to the terminals to enable a current path outside the capacitor.

For products with round or cylindrical packaging, the electrodes are wound into a jellyroll configuration. The electrodes have foil extensions that are then welded to the terminals to enable a current path outside the capacitor.

III.SALIENT FEATURES

Disadvantages

i)The amount of energy stored per unit weight is considerably lower than that of an electrochemical battery (3-5 W.h/kg for an ultracapacitor compared to 30-40 W.h/kg for a battery). It is also only about 1/10,000th the volumetric energy density of gasoline.

ii)The voltage varies with the energy stored. To effectively store and recover energy requires sophisticated electronic control and switching equipment.

iii)Has the highest dielectric combination of all types of capacitors.

Advantages

i)Extremely high rates of charge and discharge.

ii)Little degradation over hundreds of thousands of cycles.

iii)Good reversibility

iv)ow toxicity of materials used.

v)High cycle efficiency (95Vo or more)

IV.EFFICIENCY

Unlike batteries, the ultracapacitor has the same efficiency during charge or discharge. This enables the ultracapacitor to be recharged quickly without current limiting as long as the current is within the rated current for the device.

The only efficiency losses associated with ultracapacitors are due to internal resistance of the device resulting in IR drop during cycling. For most uses the ultracapacitor efficiency is in excess of 98%. For high current or power pulsing the efficiency is reduced. Typical efficiency under high current pulses is still greater than 90%.

V.SCOPE OF IMPROVEMENT

The advanced ultracapacitor can be effectively used in all the applications where existing ultracapacitors are already used or are planned to be used. The advanced capacitors are especially effective for systems where relatively high voltage and high stored energy are necessary. Particularly these are various transportation systems (recuperation of the brake energy, start of diesel aggregate, stop-start cycles, on board electric equipment). Also these are Forklift and Crane Applications to complement batteries or replace batteries. Also these are various Uninterruptible Power Supply (UPS) Solutions in case short grid power disturbances like short switch offs and instability of the voltage and frequency happen (telecommunications, data centers, hospitals, industrial buildings, broadcast systems, any remote installations). These are also various backup power supply systems used in the event of long grid power disturbances or outages (the same examples as for the UPS systems plus switching on emergency equipment like lighting, diesels for feeding of emergency valves, ventilation, and cooling systems).

The principal effect expected from advanced ultracapacitors is in their green nature. Another principal effect is in ability of developing high voltage storage systems for specific applications in electric grids and power stations. Another principal effect is in a higher accumulated energy, giving rise also to a smaller weight and dimensions for application in transportation systems

VI.CONCLUSION

Ultracapacitors are actually available with energy densities around 5 Wh/kg, still relatively low densities with a high cost. It is expected that in the future their energy density will reach 30 Wh/kg. This leads us to consider super capacitors as an interesting option in a near future when problems of high cost and low energy density are solved.

Nowadays, ultracapacitor would be a solution to a system that injects power for one hour, but they wouldn’t be a solution to a system that injects power for one day. The fact that they don’t store high quantities of energy and that they need a high number of modules increases the costs a lot.

VII. FUTURE OF ULTRA CAPACITOR

The ultracapacitor is emerging as a key enabling technology for use in fuel-efficient transport as well as in renewable energy. The Future of Ultracapacitors takes an in-depth look at the drivers and challenges shaping the future of the market. It also outlines the latest technology and material developments in this sector.

NEU (nanotube enhaced ultracaps) can have a three times greater energy density as common acid batteries. And when working at low voltages the y can last as long as a century. Need to devellop low voltage high efficiency electronics and very high efficient electric motors.

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Dr. Debmalya Bhattacharya is working as Associate Professor in Vel Tech Technical University Chennai. He has published several papers on DSP & Wireless communication in National and International Journals. His current research interests are DSP, Antenna Design & Wireless Communications and Renewable Energy Sources.

Mr. Ashish Kumar pursuing B .tech-3rd year from Veltech Technical University, Chennai. He has completed one project, published two papers & attended five workshops related to Electronics & Communication Engineering apart from academics .He has also done three inplant trainings in Advanced Telecommunication, SIC & Govt. recognized lab.

Miss Kriti Singh pursuing B.tech-3rd year from Veltech Technical University, Chennai, India. She has completed one project, two paper presentations & four workshops related to Electronics & Communication Engineering apart from academics .She has also done three inplant trainings related to Advanced Telecommunication & RailNet Communication.