



## 19CH101– ENGINEERING CHEMISTRY

### Unit-5 ENERGY SOURCES AND STORAGE DEVICES

#### SUPER CAPACITORS

A supercapacitor (SC), also called an ultracapacitor, is a high-capacity capacitor with a capacitance value much higher than other capacitors, but with lower voltage limits, that bridges the gap between electrolytic capacitors and rechargeable batteries. It typically stores 10 to 100 times more energy per unit volume or mass than electrolytic capacitors, can accept and deliver charge much faster than batteries, and tolerates many more charge and discharge cycles than rechargeable batteries.

Supercapacitors are used in applications requiring many rapid charge/discharge cycles, rather than long-term compact energy storage — in automobiles, buses, trains, cranes and elevators, where they are used for regenerative braking, short-term energy storage, or burst-mode power delivery. Smaller units are used as power backup for static random-access memory (SRAM).

Unlike ordinary capacitors, supercapacitors do not use the conventional solid dielectric, but rather, they use electrostatic double-layer capacitance and electrochemical pseudocapacitance, both of which contribute to the total capacitance of the capacitor, with a few differences.

#### Storage principles and types

Electrochemical capacitors use the double-layer effect to store electric energy; however, this double-layer has no conventional solid dielectric to separate the charges. There are two storage principles in the electric double-layer of the electrodes that contribute to the total capacitance of an electrochemical capacitor:

- Double-layer capacitance, electrostatic storage of the electrical energy achieved by separation of charge in a Helmholtz double layer.
- Pseudocapacitance, electrochemical storage of the electrical energy achieved by faradaic redox reactions with charge-transfer.

Both capacitances are only separable by measurement techniques. The amount of charge stored per unit voltage in an electrochemical capacitor is primarily a function of the electrode size, although the amount of capacitance of each storage principle can vary extremely.