In this issue

Supercapacitors

Batteries and capacitors of various sizes, descriptions, electrical capacities and performances are in use to meet a variety of day-to-day applications as in torches, radios, watches, fluorescent lights and automobiles.

The principle components of a battery are two dissimilar electrodes located in a conductive medium. It is generally a large energy-density device having finite lifetime in use.

A capacitor, on the other hand, is based on two identical electrodes and a sandwiched non-conducting dielectric medium. It is generally a low energy-density device and has a fairly long time associated with its recyclability. Large capacitor banks, bulky and prone to failure, are resorted to store large energy-density using several smaller individual capacitors.

Capacitors are classified according to the dielectric material (e.g. film and ceramic capacitors), electrode material (e.g. aluminum and tantalum capacitors) or application (e.g. trimmers, motor start capacitors and microwave capacitors). In addition, capacitors come under two broad categories, viz. variable and fixed capacitors. The fixed capacitors are further classified into electrostatic (using insulating dielectrics), electrolytic (using solid or liquid electrolytes) and electrochemical capacitors.

Demand for advanced energy storage technologies and devices covers two extreme requirements. Firstly, one seeks devices that provide fast discharge capabilities and high cycle life of a capacitor and energy-density performance of a battery with other desirable qualities like low ESC, low leakage currents and operation over a wide temperature region. On the other hand, one seeks devices with large capacitance combined with slow rate of discharge and small package as a non-battery reserve power source for use in microcomputers and to maintain contents of low dissipation volatile memories for several months.

Recent advances in the electrochemical capacitors, also referred to as double-layer capacitors, have resulted in a new type of capacitors known as 'supercapacitors' or 'ultra-capacitors'. These have capacitance (energy capable of being stored) of several hundred farads (generally, the capacitance of normal capacitors is in the range of fractions of a farad). These supercapacitors are said to have enabled applications for which neither a battery nor a capacitor could provide the required power and energy, such as for load leveling in switching power supplies, turbochargers for batteries, etc. In certain capacitor–battery hybrid power packs for telecom applications for example, in digital cellular phones, pagers, etc., the supercapacitor is used resulting in minimizing voltage loss and battery drain; longer run time, high pulse power application is also thereby achieved.

The article by A. K. Shukla *et al.* (**page 1656**) reviews developments in 'supercapacitors'. After introducing scientific fundamentals, the article deals with materials used and applications. Finally, the authors 'stress on the scope for technology development in a multidisciplinary approach involving materials science, electrochemistry and polymer technology'.

K. R. Rao

Churn the sea to reduce heart diseases

An injury on our body like a cut or a slash, triggers a healing process that seals the cut blood vessel and prevents blood loss. This protects the body from haemorrhage and saves life. However, in a diseased functional blood vessel affected by atherosclerosis, the very same process of forming clots within the blood vessel manifests as a danger to life. These clots can travel in the bloodstream and clog the arteries of the heart leading to thrombosis. The clot formation process involves the conversion of a soluble plasma protein called fibrinogen into an insoluble protein, fibrin, which with a thread-like structure, networks to trap platelets like a plug. This finally achieves the coagulation phase, which is the transformation of the plug into a clot. Several anti-coagulant drugs are in the market. Heparin, is one such primary anti-coagulant drug. Heparin is extracted from internal organs of animals and purified, which makes its production both expensive and difficult. It has side effects too. Thus, looking for alternative sources of anti-coagulant drugs is essential and has led researchers in the field of anti-thrombotics to hunt in the sea or freshwater bodies for solutions.

A new source of anti-coagulant drugs has emerged from marine algae. These marine algae or seaweeds have the distinction of being one of the oldest in the plant kingdom, inhabiting the sea for millions of years. They have a primitive structure with little tissue differentiation, no roots, stem, leaves or flowers. Variation in their size is seen from microscopic cells to giants even growing to about 100 feet in length. Found in the ocean or in brackish water along the coast they are a rich source of food, fuel, manure, industrial raw material such as agar–agar, algin and alginates, chemicals and pharmaceuticals. Algae are an important link in the food chain of aquatic species. Algal photosynthesis is used in environmental management of wastes and sewage. All of its varied uses make this coastal resource also important to human welfare.

In 1936, marine algal extracts with blood anti-coagulant properties was first reported. Subsequently, research on the three major divisions of marine algae, i.e. The Reds (Rhodophyta), The Browns (Phaeophyta) and The Greens (Chlorophyta) has found a class of

carbohydrates (sulphated polysaccharides or SPS) responsible for this anti-coagulant activity. Marine algae belonging to different species have been screened for the active component and their extraction, purification, structure and anti-coagulant activity evaluated.

India's long coastline is rich in marine algae and is an important bio-resource contributing to marine bio-diversity. Indian species of algae such as *Grateloupia indica* (red algae), *Sargassum cinctum* (brown algae) and thirteen Codiaceae species of green algae screened, in particular, *Codiaceae dwarkense* and *Codiaceae tomentosum* are some of the algal species showing promising anti-coagulant properties and have been harvested from Indian waters.

The article by Shanmugam and Mody (**page 1672**) of this issue reviews this interesting and commercially important field of finding novel drugs from marine algal sources with particular reference to anti-coagulant properties. Marine bio-resources such as algae open vast possibilities for research into an economically sustainable source of anti-thrombotic pharmaceuticals.

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