NET, IAS, State-SET (KSET, WBSET, MPSET, etc.), GATE, CUET, Olympiads etc.: Science and Technology Electrically Conducting Polymers (ECPs)

Electrically Conducting Polymers (ECPs)

1. Organic polymers have always been believed to be insulators of heat and electricity and that is why their use in making switch boards, MCBs, thermal insulations, handles of utensils etc. A key discovery in the development of conducting polymers was the discovery in 1973 that the inorganic polymer, polysulfur nitride (SN) x, is a metal. Below a critical temperature of about 0.3 K (SN) , x, becomes a superconductor.
2. The first major breakthrough in the field of electricity conducting polymers occurred in 1977.
3. For the first time it was demonstrated that polyacetylene (PA) , an intrinsically insulating polymer, could become highly conducting on treatment with oxidizing (electron-accepting) or reducing (electron-donating) agents. This process was called doping.
4. Another major advancement happened in 1980, when poly (p-phenylene) (PPP) was doped to conductivity level quite comparable to that of PA. This polymer was the first example of the nonacetylenic hydrocarbon polymer that could be doped with an electron-acceptor or an electrondonor to give polymers with conducting properties. This discovery paved the way for a number of new conducting polymers.

Applications of Electrically Conducting Polymers

1. These polymers are extremely promising and find tremendous use in our day-to-day life with a wide range of products extending from the most common consumer goods like rechargeable batteries and microelectronic goods to highly specialized applications in space, aeronautics and electronics.
2. Around the 1990s, the field received a major boost when it was first discovered that polymers such as poly (phenylenevinylene) (PPV) luminesce when a voltage is applied to a thin film between two metallic electrodes. This led to the first polymer light-emitting diode.
3. These devices can emit light in a variety of colours. Emissive displays fabricated from polymer LEDs were introduced as products in cell phones and personal digital

assistants (PDAs) in 2003.

4. Polyaniline (PANI) has turned out to be one of the most extensively commercialized electronic polymers, often blended or chemically combined with other industrial plastics to obtain the most desirable features. It is used, for example, in electromagnetic shielding, and when dispersed in paint as an anti-rust agent. PANI is also belied to play a major role in the emerging area of nanoscience.
5. Sensors: A sensor is a device that measures a physical quantity and converts it into a signal that can be read by an observer or by an instrument. The ability of PANI to change the electrical conductivity and colour upon exposure to acidic, basic and some neutral vapours or liquids finds its usefulness in the field of sensors, detectors and indicators. PANI has been used to fabricate sensors for liquefied petroleum gas, hydrogen peroxide, humidity, mercuric ion, pH, and biosensor. Lightweight and rechargeable batteries: This is one of the most publicized and promising applications of ECPs.
6. The polymer electrodes of these batteries have a longer shelf life than the metal electrodes of any ordinary battery.
7. Another advantage of polymer electrode batteries is the absence of toxic materials in them and therefore disposal problems are minimized.
8. Artificial nerves: Electrical fields can stimulate the healing of bone, cartilage, skin, spinal and peripheral nerves and the connective tissues. As a result, researchers have sought to incorporate electrical signals directly to biomaterials. Due to biocompatibility of some conducting polymers, they may be used to transport small electrical signals through the body, i.e. … They act as artificial nerves.
9. Conducting polymers are promising materials of the future and will continue to have an impact on the progress of science and technology.

Stainless Steel

1. Stainless steel is one of the very few alloys that are 100% recyclable, it can, therefore, be melted time and time again and reformed into a new product.
2. An average stainless steel object is composed of about 60% recycled material (25% coming from end-of-life products and 35% from manufacturing process scraps) .
3. Actually, stainless steel is not consumed, it remains as a part of the sustainable closed loop system. Also, the manufacture and processing of stainless steel do not cause adverse effects on the health of workers. Plastic, on the other hand, is a major pollutant when manufactured or disposed of. Plastic items that clutter landfills may leach out dangerous chemicals.

Applications

1. Stainless steel is a very versatile and useful material. Because of its unique combination of properties that offers attractive benefits, stainless steel is used in a wide variety of products, ranging from the mundane kitchen sink to the sophisticated nuclear reactor. It

has revolutionized most modern industries, including construction, transportation, food pharmaceuticals, health-care and power.

2. Stainless steel has one of the most hygienic surfaces that are very easy to clean, as the surface has no pores or cracks to harbour bacteria, dirt or grime. It will not affect the flavour, as it does not react with food. Even acidic foods like tomatoes and vinegar can be safely cooked in it. These features have mode stainless steel indispensable for the preparation, delivery and storage of food. *Courtesy: Science Reporter*