National Institute of Technology Rourkela

Departmental Seminar

Seminar Title	: A study on carbon-based hybrid supercapacitor electrodes: design, fabrication, and testing
Speaker	: Manoranjan Mandal
Supervisor	: Prof P. Mahanandia
Venue	: Google Meet (https://meet.google.com/irk-crue-wwi)
Date and Time	: 27 Apr 2023 (4:30 PM)
Abstract	: Over the past decades, energy demand has been increasing globally due to the depletion of fossil fuels and the fast-growing population. To meet this rapidly increasing worldwide energy consumption, advances in renewable energy technology and storage devices are substantial. In this regard, supercapacitors (SCs) are the type of energy storage devices that have enticed special consideration due to their longer lifecycle (>100000 cycles), fast charging-discharging process, and high power density. These outstanding properties of SC make a wide range of potential applications, such as in-memory backup systems, hybrid electric vehicles, LED drivers, energy management fields, and industrial power supplies. The SCs bridge energy and power gap between the conventional capacitor and battery. However, low energy density is the primary concern for SC. Hence, researchers are looking for novel electrode materials and new designs to improve energy density without losing its power density. Carbon-based SCs are widely used in commercial applications owing to their unique physical and chemical properties. Among various carbon materials, activated carbon (AC), carbon nanotubes (CNTs), and graphene (GR) are widely used as electrode materials for SC. The carbon-based SC offers excellent power density and cyclic stability; however, the energy density of carbon-based SC is very low to fulfill the energy demands. The metal oxides involve reversible redox reactions that enable electrodes to accumulate more ions and result in higher energy density in the metal oxide-based SC. Hence, the performance of carbon-based SC could be further improved by integrating it with metal oxides. This has motivated us to combine carbon materials (AC, CNTs, and GR) with metal oxides to design a hybrid SC. The electrochemical performance of the fabricated hybrid SC has been investigated using cyclic voltammetry (CV), galvanostatic charge-discharge (GCD) and electrochemical impedance spectroscopy (EIS). The fabricated SC device has been subjected to LED light test for practical applications. The finding reveals that the fabricated hybrid SC device could be the best candidate for practical applications.