National Institute of Technology Rourkela

Registration Seminar

Seminar Title	: Fabrication of Polyaniline/conducting carbon/(Zn-Ni-Co) MOF based electrodes with optimized energy density and extended cycle life for energy storage applications
Speaker	: Asfaq Ali (Rollno : 524ch1001)
Supervisor	: Tapas Das
Venue	: New Seminar Hall, Department of Chemical Engineering
Date and Time	: 18 Sep 2025 (4:30 P.M.)
Abstract	: The increasing demand for efficient energy storage devices has positioned supercapacitors as a vital alternative to conventional batteries due to their high-power density, rapid charge&ndashdischarge rate, and excellent cycling stability. Despite these advantages, their low energy density remains a critical limitation, driving the need for advanced electrode materials with enhanced electrochemical performance. Combining different classes of materials is considered an effective strategy to overcome individual shortcomings and unlock synergistic effects. In this study, a ternary composite of polyaniline (PANI), zinc-based metal&ndashorganic framework (Zn-MOF), and graphitic carbon nitride (g-C_3N_4) was synthesized to exploit the redox activity of conducting polymers, the porosity and tunable structure of MOFs, and the high conductivity of carbon-based frameworks. Structural analysis confirmed the successful integration of all components, while microscopic and spectroscopic studies revealed interconnected morphologies and uniform elemental distribution. Electrochemical characterization further highlighted that the composite exhibits improved capacitance, better charge transport, and enhanced stability compared to the individual materials. The outcomes of this work demonstrate that the combination of polymeric, porous, and carbonaceous phases in a single hybrid structure significantly enhances overall electrochemical properties. This establishes the PANI/Zn-MOF/g-C_3N_4 composite as a promising electrode candidate for high-performance supercapacitors and provides valuable insights into the rational design of multifunctional hybrid materials for sustainable energy storage applications.