F.NO.COE/Ph.D./(Notification)/557/2024 Date of Notification: 09/04/2024

Name of the Candidate: Aasim Hussain
Name of the Supervisor: Prof. Azher Majid Siddiqui
Name of the Co-Supervisor: Dr. Anju
Department: Physics, JMI

Title: Effects of Swift Heavy Ion Irradiation on the Conducting Polymer Nanocomposites and their Applications

Findings

The research thesis undertakes a comprehensive exploration into conducting polymers and their nanocomposites, with a particular focus on the transformative effects of swift heavy ion (SHI) irradiation. It begins by outlining the classification of these materials and their applications, followed by an in-depth discussion on SHI irradiation techniques and their theoretical underpinnings. Subsequently, a detailed comparative study is conducted on Polypyrrole/Zinc oxide (PPy/ZnO) nanocomposites synthesized through modified chemical oxidation and electrochemical deposition methods. The former yields PPy nanotubes and ZnO nanourchins dispersed in N-Methyl Pyrrolidine (NMP), while the latter results in uniform thin films on a stainless steel substrate. Structural and electrical property characterizations reveal the unique properties of the hybrid nanomaterials synthesized. Further investigation is carried out on the effects of SHI irradiation on PPy/ZnO nanocomposites fabricated via electrodeposition. Notable changes in morphology and electrochemical behavior are observed at varying irradiation fluences, with enhanced capacitive properties noted at lower fluences attributed to increased surface roughness facilitating charge storage. Electrochemical assessments demonstrate improvered specific capacitance, cyclic stability, and power and energy densities. The influence of swift ion irradiation on polyaniline/zinc oxide (PANI/ZnO) nanocomposite films synthesized through electrodeposition is also explored. Structural and electrical analyses reveal a nuanced interplay between ion fluence and electrical conductivity, with lower fluences enhancing conductivity and mobility, while higher fluences induce degradation. This underscores the potential of PANI/ZnO nanocomposites in optoelectronic and energy storage applications. Finally, the research findings are synthesized into a comprehensive conclusion, highlighting the implications of the study and proposing avenues for future research exploration within the realm of SHI irradiation and nanocomposite materials.