



Reduced Graphene Oxide based bimetallic nanocomposite electrodes for next generation supercapacitors and advanced energy storage devices

Summia Manahil, Gul Rahman*

Institute Of Chemical Sciences, University Of Peshawar, Khyber Pakhtunkhwa, Pakistan

Email: summiyamanahil@gmail.com



ABSTRACT

A ternary nanocomposite of $\text{MnO}_2\text{--Cr}_2\text{O}_3\text{--rGO}$ was synthesized using an in-situ chemical precipitation method at 80°C with graphene oxide prepared by the Hummers process. The structure and morphology of the materials were confirmed by XRD, SEM and EDX which verified the presence of C, O, Mn, and Cr. Electrochemical characterization through CV, GCD, and EIS in 1 M KOH electrolyte within a 0–0.6 V window showed favorable capacitive behavior. The $\text{MnO}_2\text{--Cr}_2\text{O}_3\text{--rGO}$ composite exhibited enhanced specific capacitance compared to the individual components, demonstrating its potential as a low-cost, high-performance electrode material for supercapacitors.

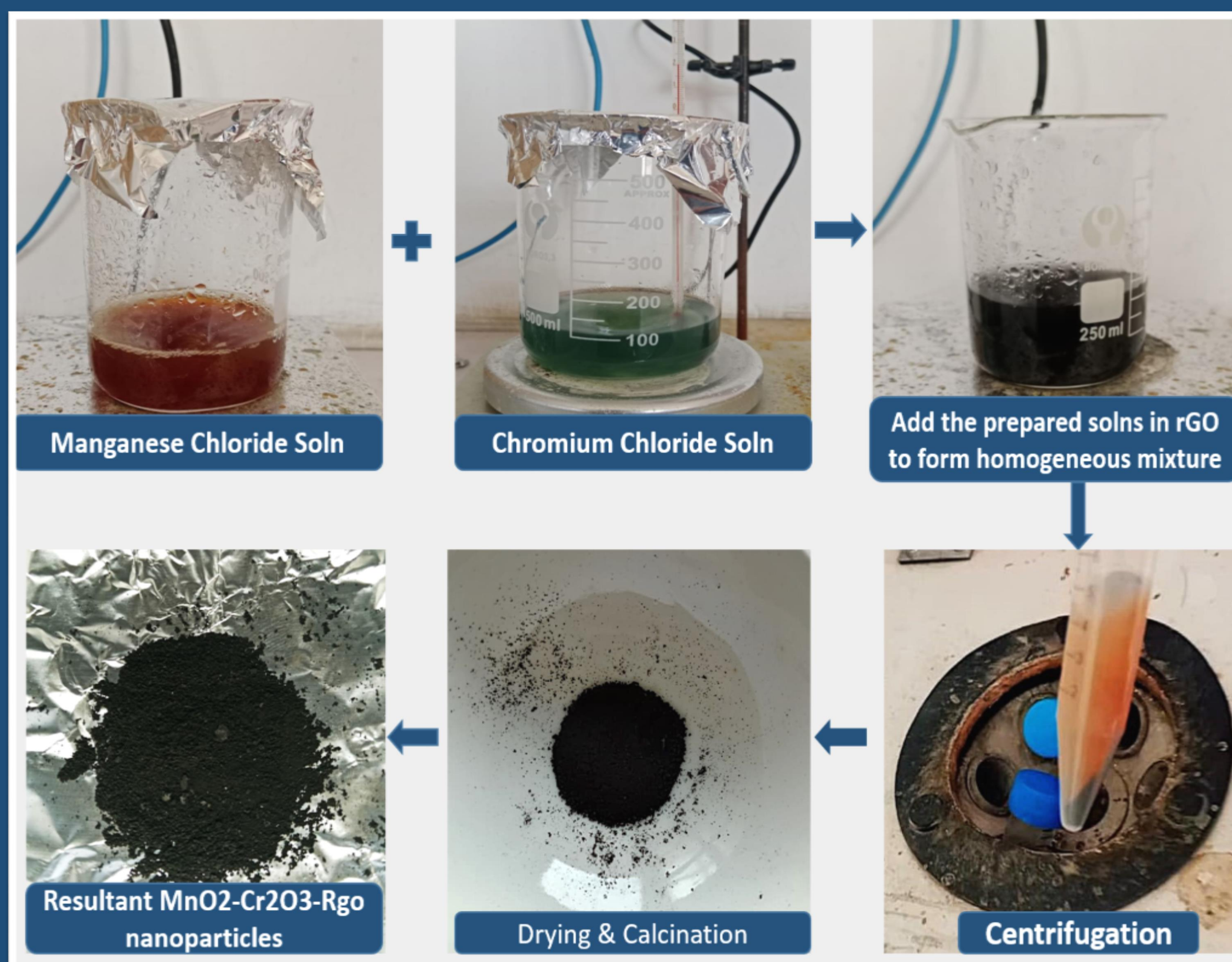
OBJECTIVES

To synthesize a novel $\text{MnO}_2\text{--Cr}_2\text{O}_3\text{--rGO}$ ternary composite using a simple and cost-effective method by optimizing experimental conditions. It aims to explore how the combination of MnO_2 , Cr_2O_3 , and rGO enhances capacitance, conductivity, and stability through their synergistic effects. The study further focuses on examining the structural, morphological, and compositional features of the composite and evaluating its potential as a high-performance supercapacitor electrode.

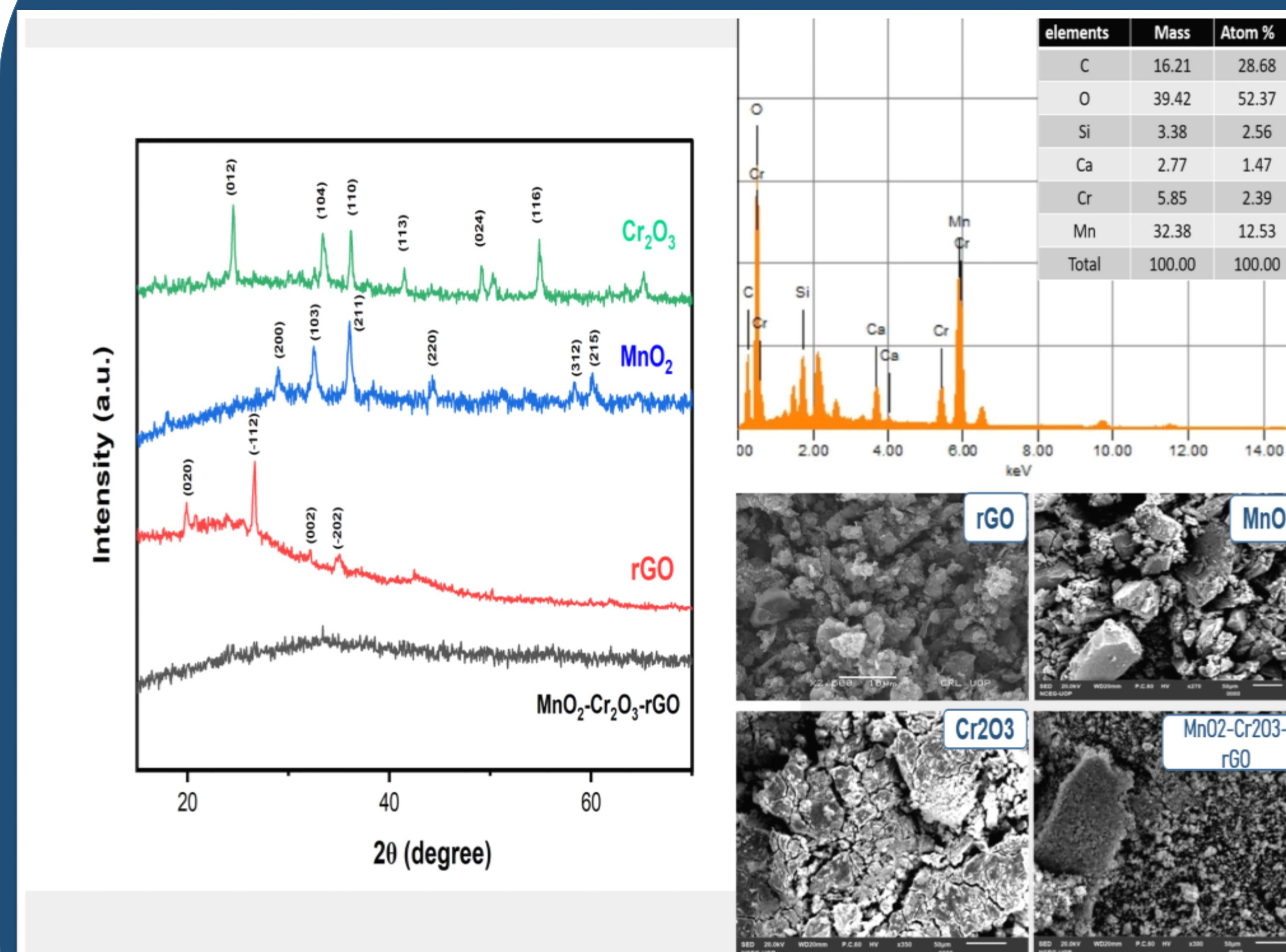
INTRODUCTION

The growing global energy demand and depletion of fossil fuels have created an urgent need for sustainable and efficient energy storage systems. Renewable energy sources such as solar and wind are promising alternatives but their intermittent nature requires reliable storage solutions. Among various options, electrochemical energy storage devices are gaining attention, with supercapacitors emerging as a promising choice due to their high power density, rapid charge–discharge capability, long cycle life, and environmental compatibility. These features make supercapacitors suitable for bridging the gap between conventional capacitors and batteries, offering great potential for next-generation energy storage technologies.

METHODOLOGY



RESULTS AND DISCUSSIONS



CONCLUSION

The $\text{MnO}_2\text{--Cr}_2\text{O}_3\text{--rGO}$ composite was successfully synthesized using a simple and low-cost precipitation method and confirmed through structural analysis. While the material exhibited an amorphous nature with the presence of key constituent elements, its electrochemical performance showed lower capacitance than rGO alone. These findings suggest that despite successful synthesis, the composite may have limited potential for high-performance supercapacitor applications.

REFERNECES

- Yadlapalli, R. T., Alla, R. R., Kandipati, R., & Kotapati, A. (2022). Super capacitors for energy storage: Progress, applications and challenges. *Journal of Energy Storage*, 49, 104194
- Mensah-Darkwa, K., Gupta, R., Ampong, D., Agyekum, E., & De Souza, F. (2022, June 08). Types of Electrochemical Energy Storage Devices. In *Encyclopedia*. <https://encyclopedia.pub/entry/23846>.
- Zhi, M., Xiang, C., Li, J., Li, M., & Wu, N. (2013). Nanostructured carbon–metal oxide composite electrodes for supercapacitors: a review. *Nanoscale*, 5(1), 72–88.