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CONCENTRATION EVALUATION OF *Garcina kola* FRUIT PULP EXTRACT ON THE ELECTROCHEMICAL PERFORMANCE OF $Mn_{0.6}Ni_{0.4}Co_2S_4/Ti_3C_2T_x$ FOR SUPERCAPACITOR APPLICATION

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1.0 INTRODUCTION & AIM

The growth of human population has led to more quest for energy to improve standard of living. Intermittency nature of photovoltaic power generation necessitates the storage of generated energy for round-the–clock use prompting the use of batteries and supercapacitors. With the flaws in battery usage, cheaper materials for supercapacitor fabrication could be answer to the world energy problem.

This work involves an easy synthesis of $Mn_{0.6}Ni_{0.4}Co_2S_4/Ti_3C_2T_x$ described here as (MMCS 0-MMCS 7) nanocomposites utilizing the coprecipitation method with varying concentrations of *garcinia kola* fruit pulp extract as green intercalant and evaluating the effect of extract concentration on the electrochemical performance of the synthesized composite

2.0 METHOD

- Garcinia kola fruit pulp extract (GKFPE) was extracted using ethanol from already dried pulp as shown in the fig.1. 10, 20, 30, and 40 g was dissolved each in 100ml of ethanol to mark different concentrations
- Coprecipitation method was used for the composite

Synthesis

- 0.2g of MXene, 0.15 M of $MnCl_2.5H_2O$, 0.3 M of $CoCl_2.4H_2O$ and 0.4 wt% $NiCl_2.5H_2O$ were dissolved in 100 ml of GKFPE and stirred at 50 °C
- 0.6 g of Na_2S was separately dissolved in 10ml of DW and added to the solution
- 0.25 M 0f NaOH was dissolved in 10 ml of DW and added to the solution
- After 8 h, the solution was centrifuged and rinsed severally
- Samples MMCS 0, MMCS 3, MMCS 5 and MMCS 7corresponding to 0.1, 0.2, 0.3 and 0.4 g/ml of GKFPE were dried at 50 °C for overnight.

Fig. 1: Experimental set-up for synthesis

3.0 RESULTS & DISCUSSIONS

3.1 XRD Results

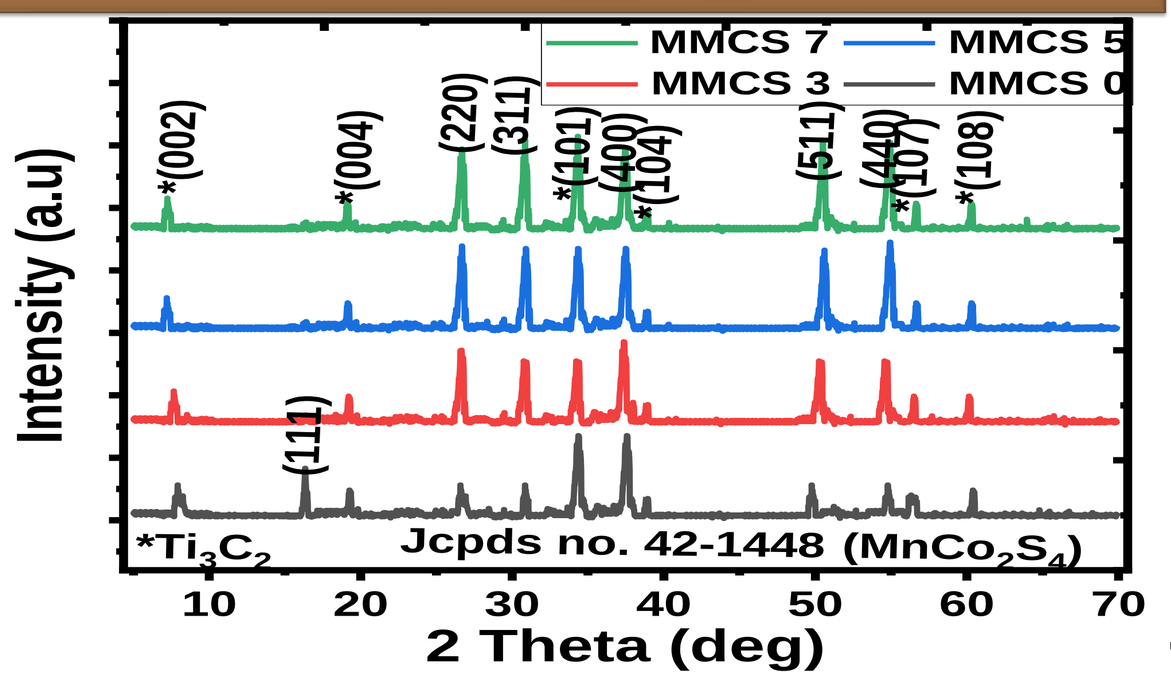

Fig. 2: XRD graph of $Mn_{0.6}Ni_{0.4}Co_2S_4/Ti_3C_2T_x$

3.2 SEM Results

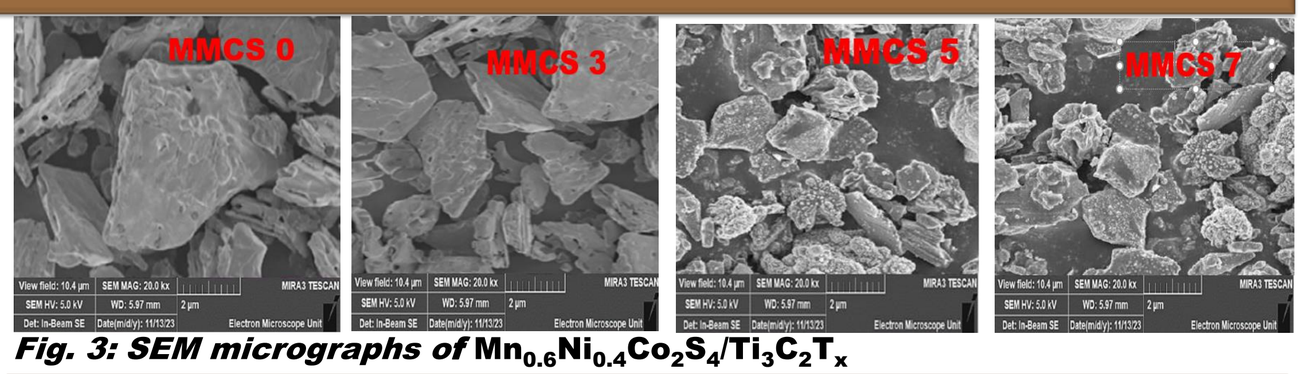

Fig. 3: SEM micrographs of $Mn_{0.6}Ni_{0.4}Co_2S_4/Ti_3C_2T_x$

3.3.1 CV Results

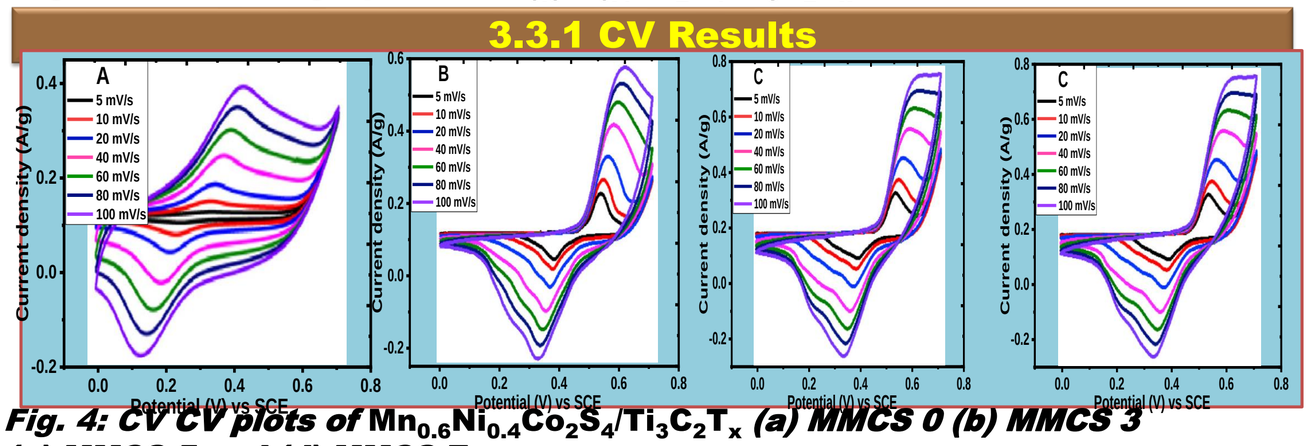

Fig. 4: CV CV plots of $Mn_{0.6}Ni_{0.4}Co_2S_4/Ti_3C_2T_x$ *(a) MMCS 0 (b) MMCS 3 (c) MMCS 5 and (d) MMCS 7*

3.3.2 GCD Results

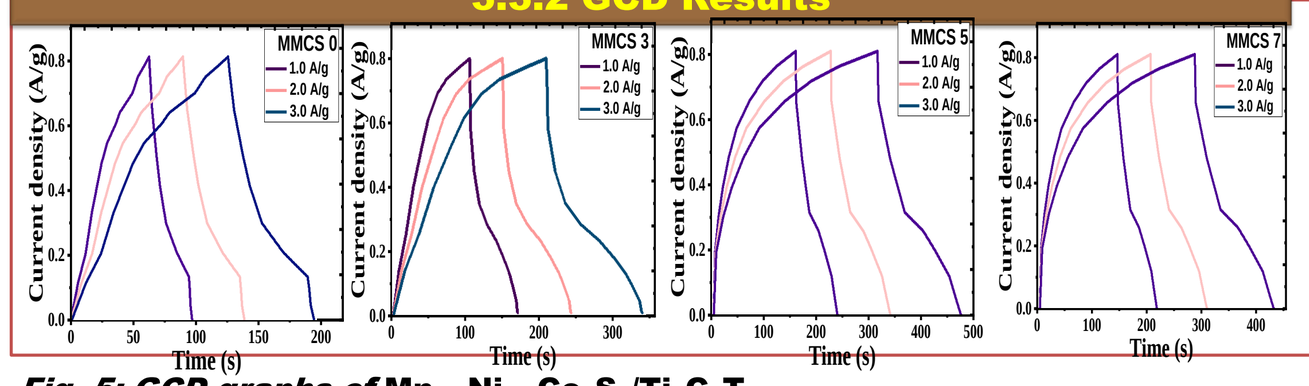

Fig. 5: GCD graphs of $Mn_{0.6}Ni_{0.4}Co_2S_4/Ti_3C_2T_x$

3.4.3 BET, EDX, and stability Results

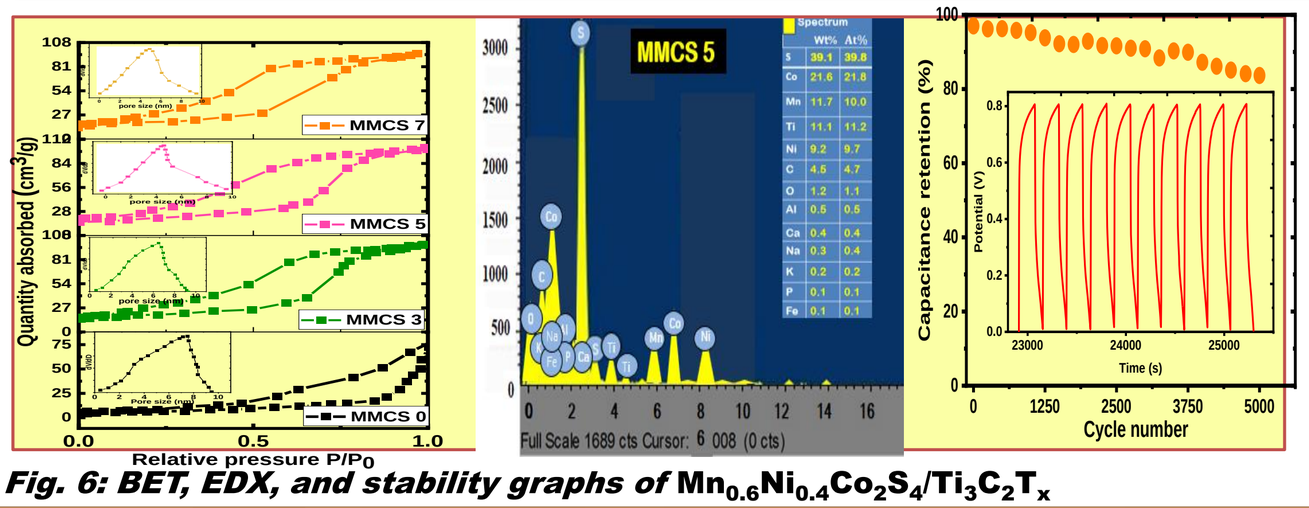

Fig. 6: BET, EDX, and stability graphs of $Mn_{0.6}Ni_{0.4}Co_2S_4/Ti_3C_2T_x$

4.0 CONCLUSIONS

Synthesis of $Mn_{0.6}Ni_{0.4}Co_2S_4/Ti_3C_2T_x$ was successfully carried out using coprecipitation method involving varying concentrations of the GKFPE as green intercalant and reducing agent. The effect of extract concentration was evaluated on the properties of the synthesized composite. An interlayer spacing increase from of 9.6 Å for $Ti_3C_2T_x$@Al to 12.04 Å for MMCS 0 and to 14.8 Å for MMCS 5 nanocomposite marking the sample with 0.3 g/ml GKFPE was revealed by the XRD while BET surface area analysis shows that MMCS 5 has the highest surface area of 102.2 m^2/g. Highest specific capacitance of 1832 C/g was recorded by MMCS 5 at 1.0 A/g with 90.3 % capacitance retention after 10,000 cycles suggesting the potential of the $Mn_{0.6}Ni_{0.4}Co_2S_4/Ti_3C_2T_x$ nanocomposite synthesized as a promising material for energy storage.

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