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$NiMn_2O_4$ spinel binary nanostructure decorated on three-dimensional graphene oxide hydrogel for non-enzymatic glucose sensor and energy storage application

Abstract
Nickel-Manganese spinel oxide, well known for electrode materials due to their exceptional chemical stability and outstanding electrochemical capacitance [1,2], is hybridized with three-dimensional (3D) graphene oxide hydrogel [3] network via a facile solvothermal process. The different analytical techniques including Raman spectroscopy, XRD, SEM and BET surface area measurements reveal that the successful formation of porous $NiMn_2O_4$/GOH nanocomposites. The $NiMn_2O_4$/GOH exhibits excellent electrochemical performance due to the high specific surface area and enhanced electrocatalytic activity by the synergetic effects between two components. The fabricated nanocomposite exhibits excellent glucose sensing performance, i.e., high sensitivity (1310.8 μA mM^{-1} cm^{-2}), a wide linear range (5 μM – 1 mM and 1 mM – 20 mM), low detection limit and fast response time (< 5s) in alkaline solution. Furthermore, the nanocomposite shows the excellent supercapacitor performance of a high specific capacitance of 396.85 $F \cdot g^{-1}$ at a current density 1 $A \cdot g^{-1}$ due to the large surface area and pseudo-capacitor behavior of $NiMn_2O_4$. We believe that the $NiMn_2O_4$/GOH nanocomposite fabricated in this study can be a possible potential material for a wide range application including glucose sensor and high energy density storage devices.
Keywords — Nickel-manganese, Spinel oxide, Graphene oxide hydrogel, Glucose sensor, Supercapacitor.

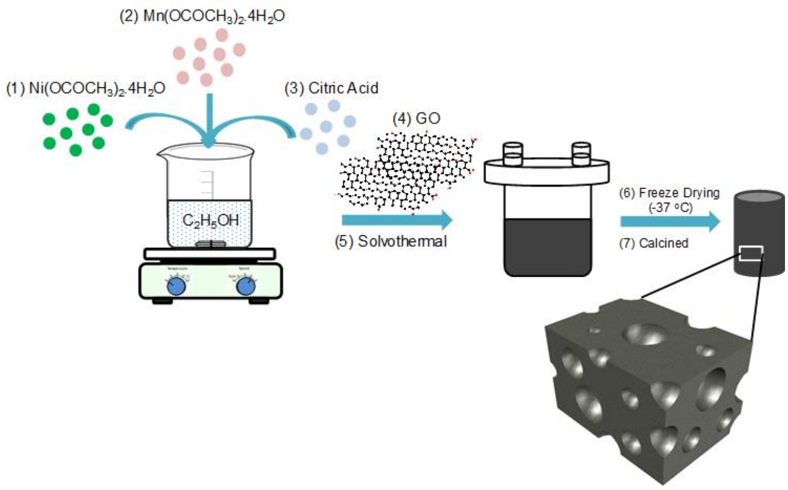

Figure 1. The illustration of $NiMn_2O_4$/GOH fabrication by solvothermal process.

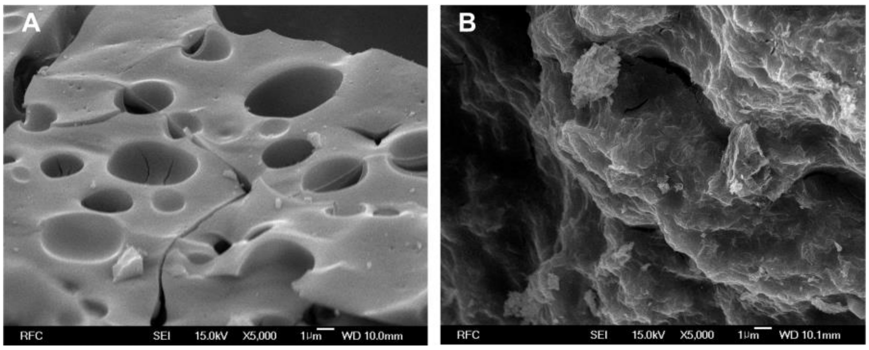

Figure 2. SEM images of (A) $NiMn_2O_4$ and (B) $NiMn_2O_4$/GOH

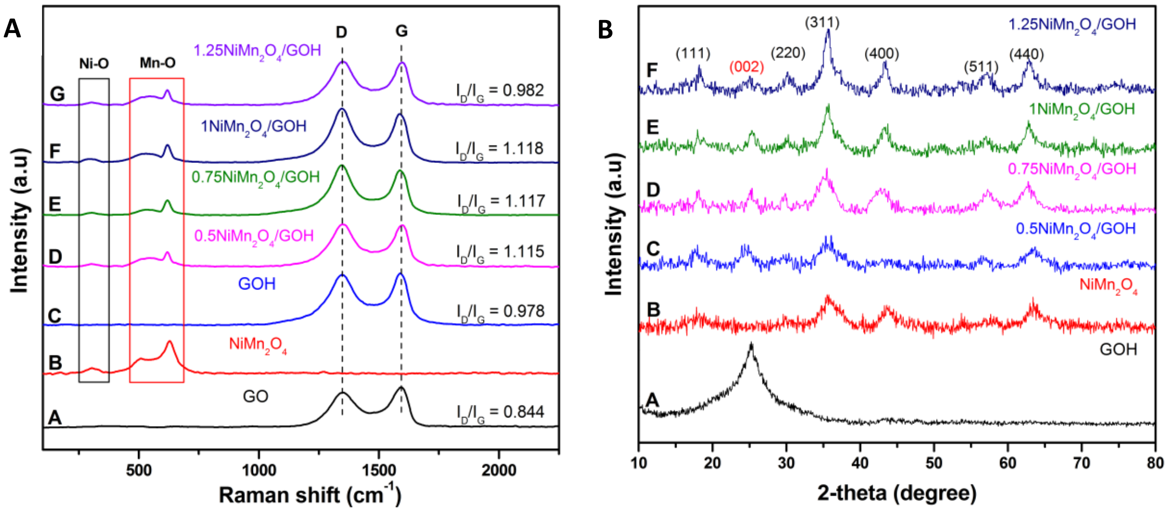

Figure 3. (A) XRD patterns and (B) Raman spectra of nanocomposite with the various content of $NiMn_2O_4$ in GOH.

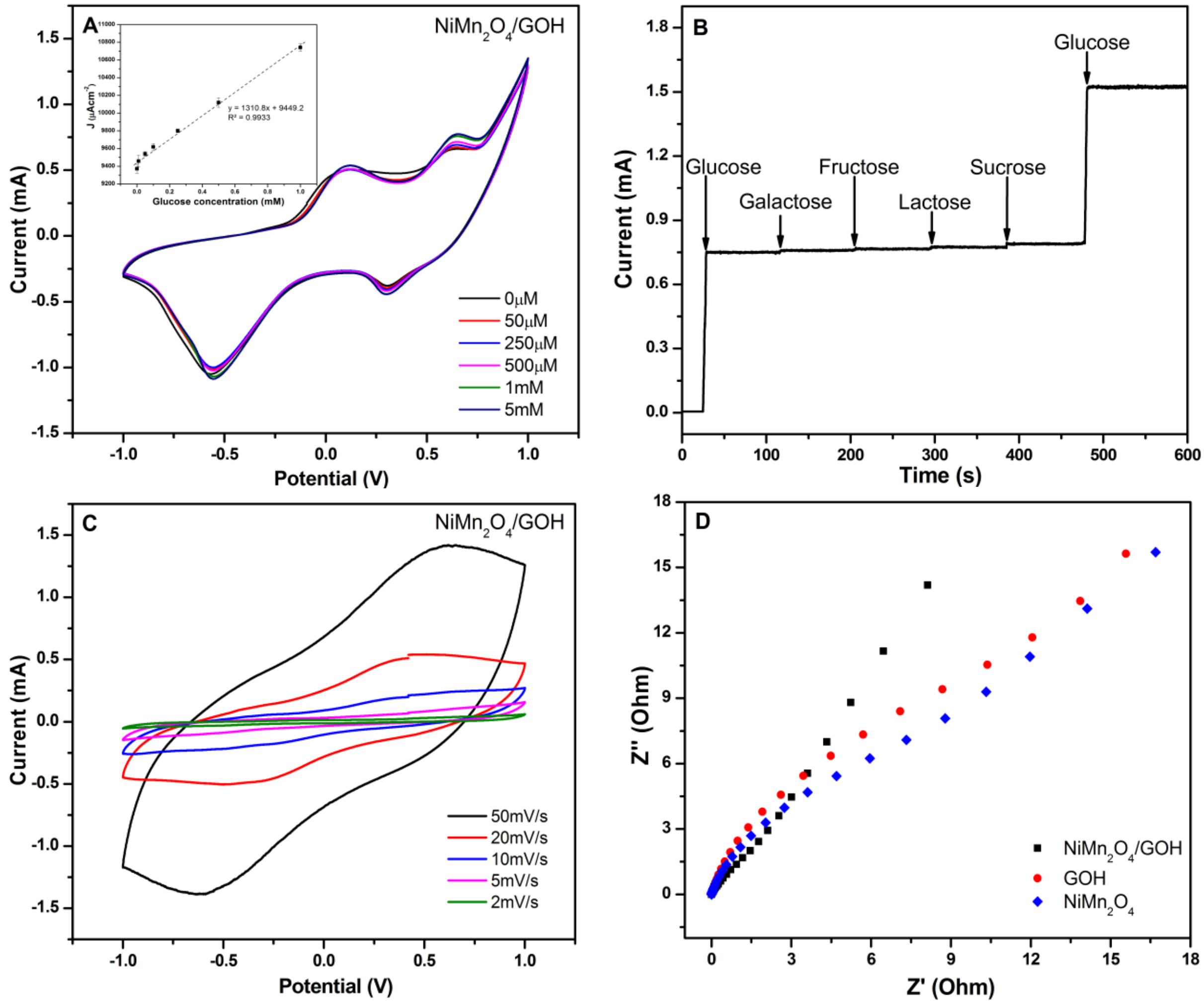

Figure 4. (A) Cyclic voltammetry (CV) of $NiMn_2O_4$/GOH in 0.1 M NaOH with various glucose concentration at 50 mV/s; (B) Amperometric response with sequentially dropped 1 mM glucose and interfering reagents; (C) CV for supercapacitor and (D) Nyquist plot of $NiMn_2O_4$/GOH at +0.6 V and the frequency range from 0.01 Hz to 100 kHz.

References

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