Electronic Supplementary Information (ESI):

A three-dimensional graphene skeleton as a fast electron and ion transport network for electrochemical applications

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I. Experimental:

Synthesis of GNS-NiO hybrid (GNS-NiO): GNS was produced by a vacuum-promoted low-temperature exfoliation approach, then the GNS-NiO hybrid was prepared as follows. First, 100 mg of graphene was pre-treated by ultrasonication for 2 h in 80 mL of distilled water (40 mL) and ethanol (40 mL) mixed solution. Next, 1397 mg of nickel (II) nitrate hexahydrate were added into the above graphene suspension and stirred for 1h. After that, the mixture was dried at 100 ℃ for 12 h. Finally, the GNS/$Ni(NO_3)_2$ mixture was heated at 400 ℃ for 3 h in Ar atmosphere to obtain GNS/NiO (equal carbon proportion with the GM-NiO hybrid).

Synthesis of NiO: NiO is synthesized by immediately heating $Ni(NO_3)_2$ at 400 ℃ for 3 h in Ar atmosphere.

Synthesis of mixture of GM and NiO (GM+NiO): The mixture was prepared by simply mixing and stirring the GM and NiO together with the same ratio as that of GM/NiO hybrid.

II. Characterization Results:

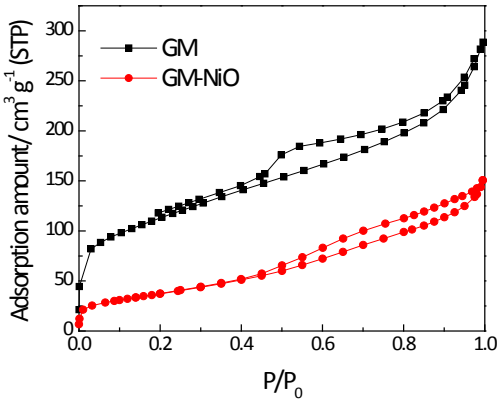

Fig. S1 Nitrogen adsorption/desorption isotherms of GM-NiO hybrid and GM.

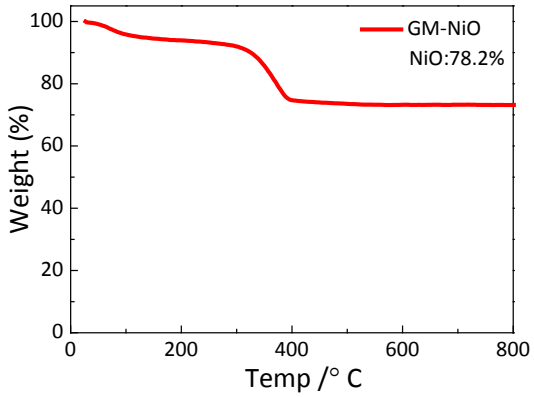

Fig. S2 TG curve of the GM-NiO hybrid in the air atmosphere.

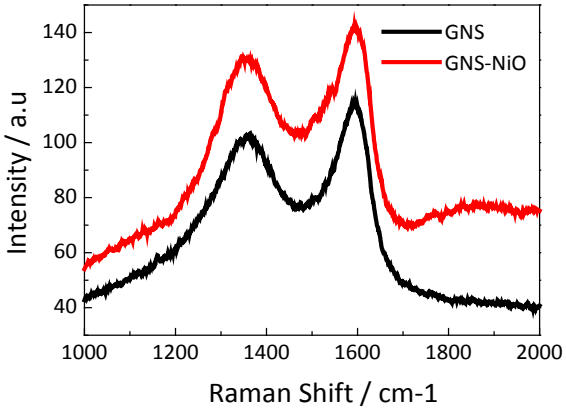

Fig. S3 Raman spectra of the GNS-NiO hybrid and GNS.

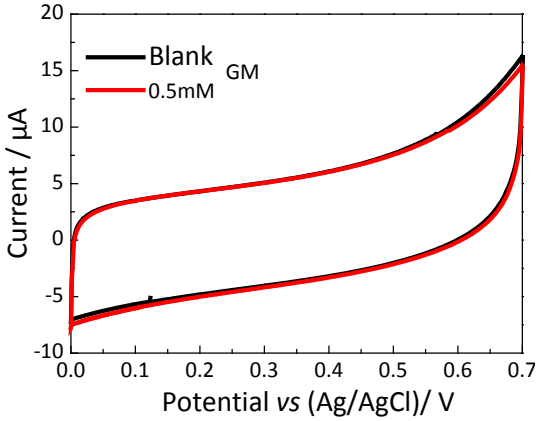

Fig. S4 CV profiles of the GM modified GC electrodes with and without glucose (0.5 mM) at 50 mV s^{-1}. No peak is observed, indicating the GM has no activity towards the glucose.

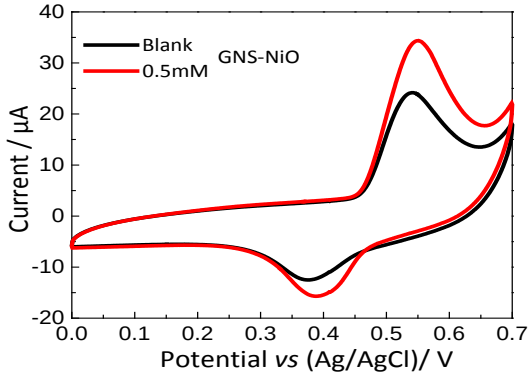

Fig. S5 CV profiles of the GNS-NiO modified GC electrodes with and without glucose (0.5 mM) at 50 mV s^{-1}.

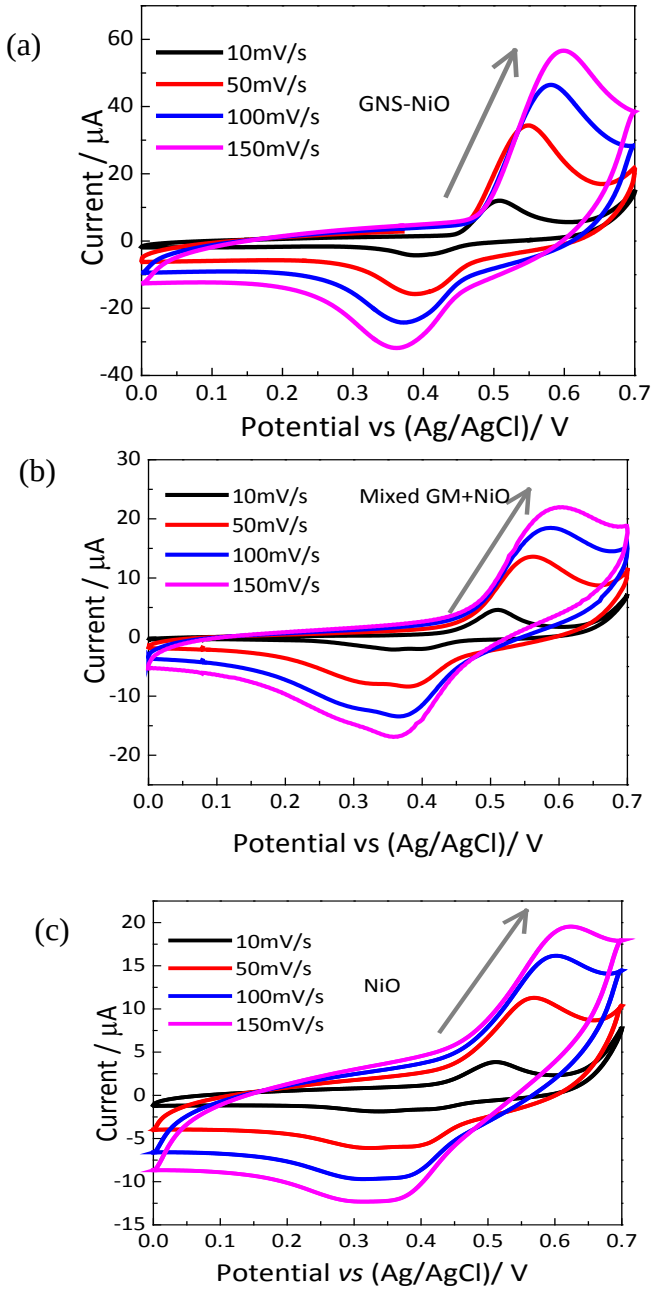

Fig. S6 (a)-(c) show the CV profiles of the GNS-NiO hybrid, GM+NiO and NiO modified GC electrodes at different scan rates in the presence of 0.5 mM glucose.

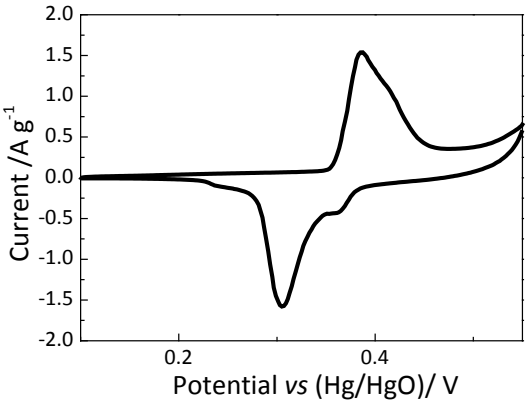

Fig. S7 CV profiles of NiO electrode measured at a scan rate of 2 mV/s.

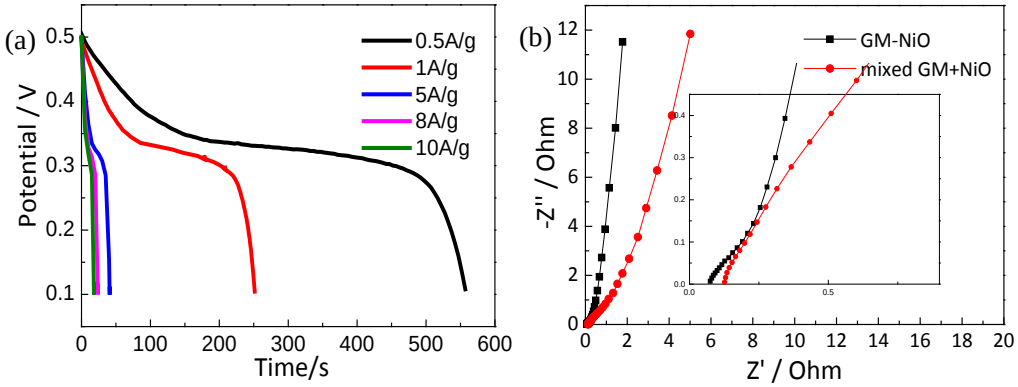

Fig. S8 Electrochemical performance of the 3D GM-NiO electrodes measured in 6 M KOH solution. (a) Galvanostatic charge/discharge curves of GM-NiO hybrid electrode with different current densities. (b) Nyquist plots of GM-NiO hybrid and mixed GM+NiO electrodes.

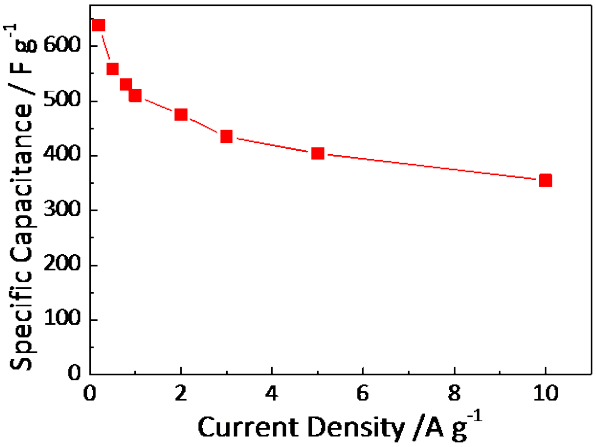

Fig. S9 The capacitance of the single electrode based on the two-electrode measurement with different current densities.