Bridging Dimension: 2D ultrathin g-C_3N_4 interfused 3D $Nd_2(WO_4)_3$ architecture for hybrid energy storage

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1. Instruments

This study's experimental setup included using a Biologic SP-300 electrochemical workstation to perform cyclic voltammetry (CV), galvanostatic charge-discharge cycles (GCD), and electrochemical impedance spectroscopy (EIS) experiments. The standard electrode design was implemented with three electrodes, a modified 1 × 1 cm^2 on nickel foam, a platinum auxiliary electrode, and an Ag/AgCl reference electrode. The electrode spacing was maintained at 0.5 cm in all trials. To determine the elemental composition and distribution of GCN@NW, X-ray photoelectron spectroscopy (XPS) was utilized with magnesium as the radiation source (PerkinElmer Phi 1600 ESCA). X-ray diffraction measurements were collected using a BRUKER USA D8 Advance Davinci diffractometer with Cu Kα radiation at angles ranging from 5 to 90º. The external morphology of GCN@NW was examined using a high-resolution scanning electron microscope (Thermo Scientific Apreo S) at 20 kV. In contrast, the internal morphology was studied using a high-resolution transmission electron microscope (JEOL Japan, JEM-2100 Plus). The ISIS300 energy dispersive X-ray spectroscopy (EDXS) equipment was used to determine the profiles of neodymium, tungsten, nitrogen, carbon, and oxygen on the surface of GCN@NW, providing insight into the surface chemistry of these materials. Fourier Transform-Infrared (FT-IR) spectroscopy with an observation range of 400-4000 cm^{-1} (SHIMADZU, IRTRACER 100) was utilized to observe the stretching frequency of functional groups, which can provide information about the chemical structure of the oxide. We used the Gaussian 09 software package the B3LYP/6-311G technique, for packing factor studies. Quantachrome ASiQwin instrument used for the adsorption-desorption isotherm studies.

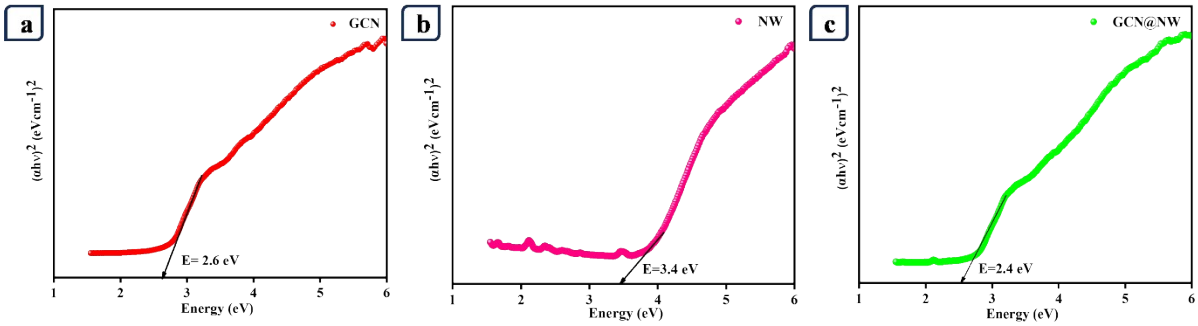

Fig.S1. Tauc plot for (a) GCN, (b) NW, and (c) GCN@NW.

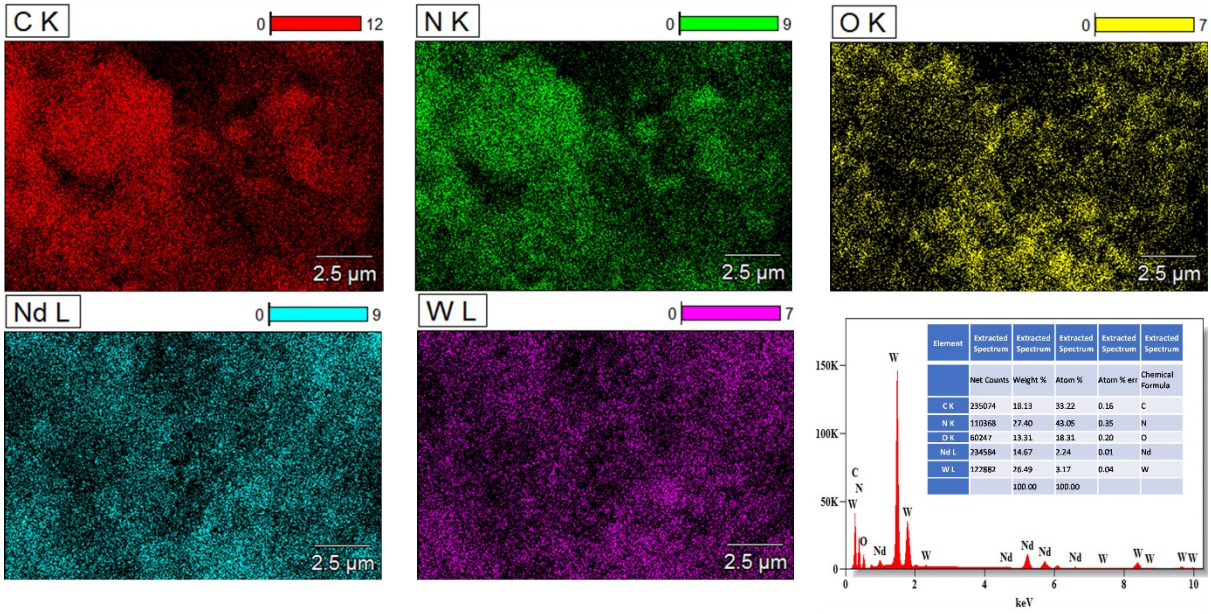

Fig.S2. Elemental mapping of carbon, nitrogen, oxygen, neodymium, and tungsten for GCN@NW and EDX spectra.

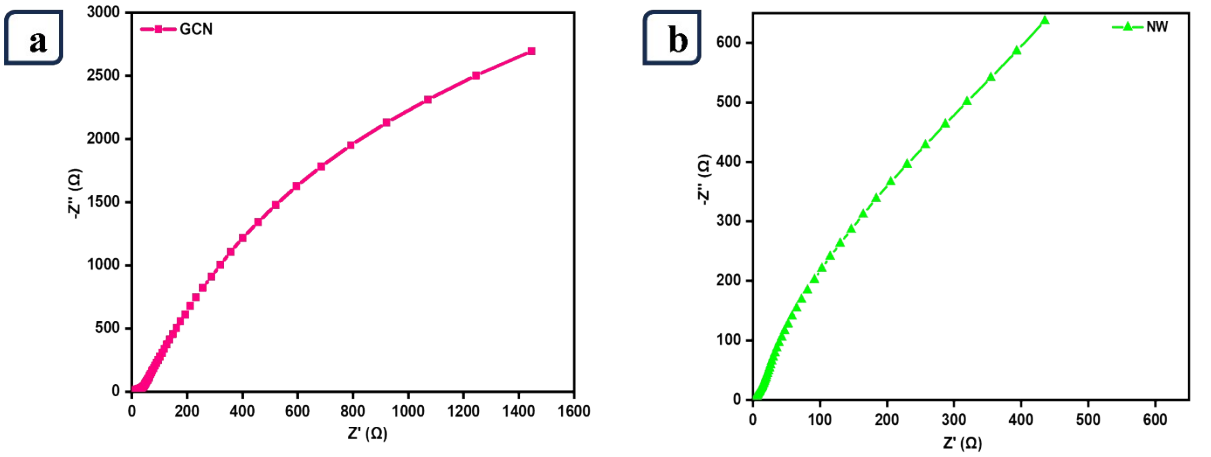

Fig.S3. EIS for (a) GCN and (b) NW.

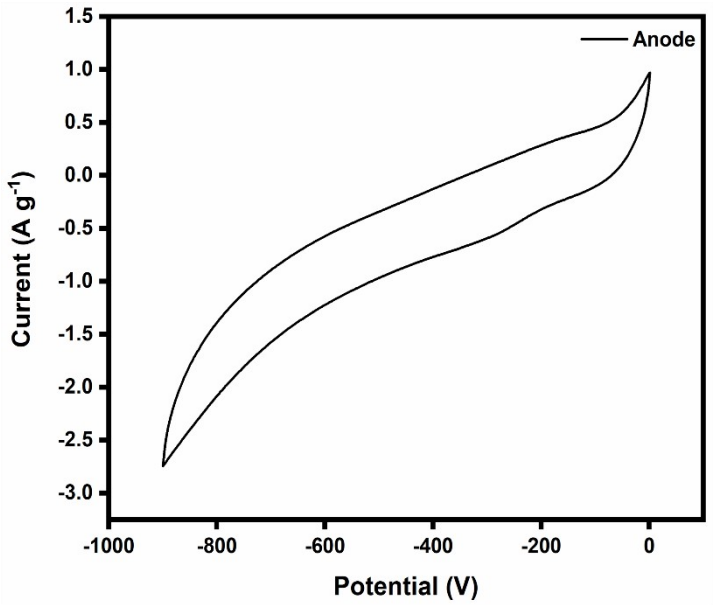

Fig.S4. Comparison CV of anode for ASC device.

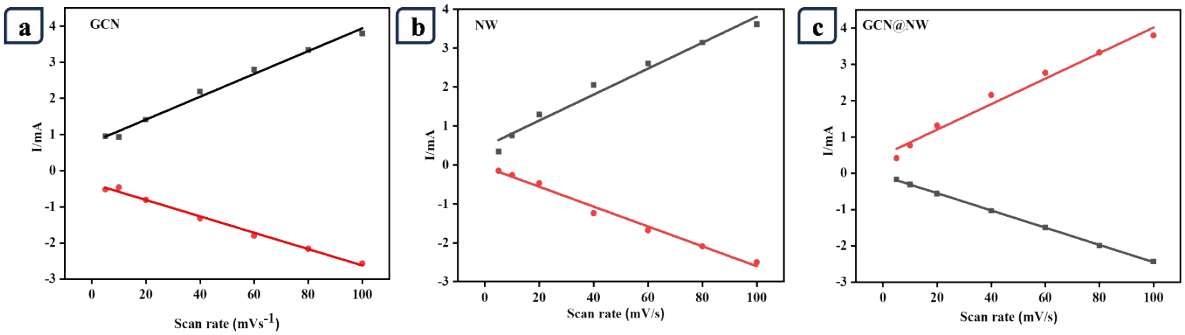

Fig.S5. Cathodic and anodic plots for (a) GCN, (b) NW, and (c) GCN@NW.

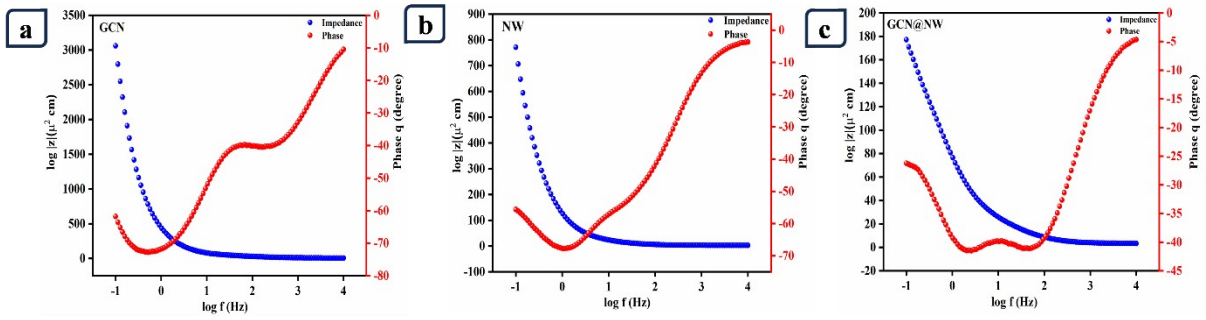

Fig.S6. Bode phase plot for (a) GCN, (b) NW, and (c) GCN@NW.

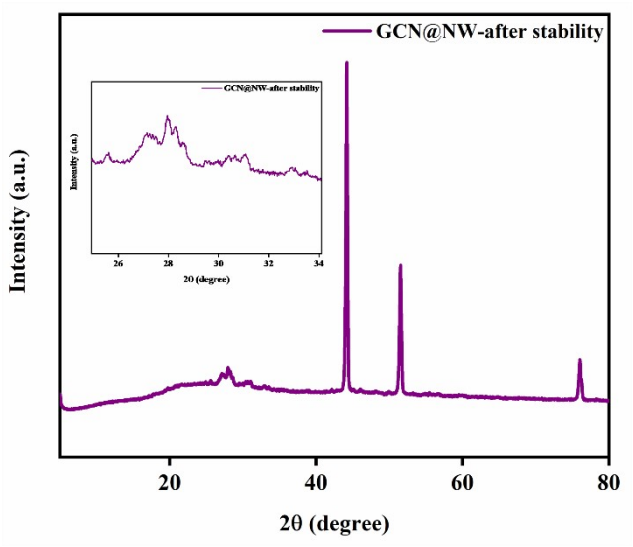

Fig.S7. XRD pattern for GCN@NW composite obtained after cyclic stability.

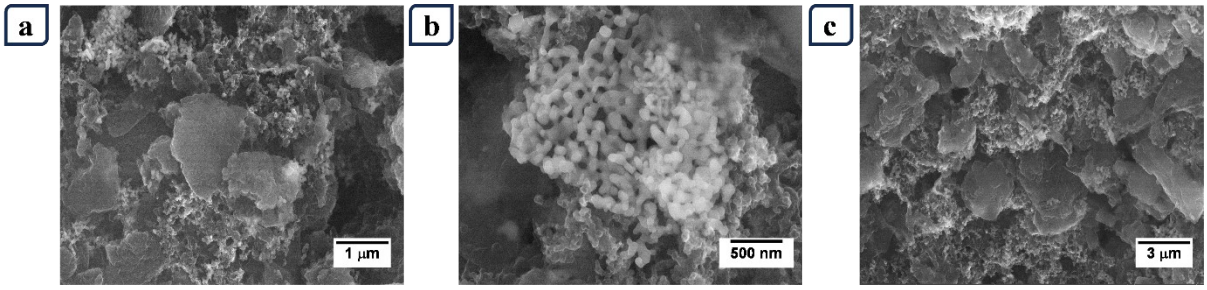

Fig.S8. SEM images for the GCN@NW composite attained after cyclic stability.

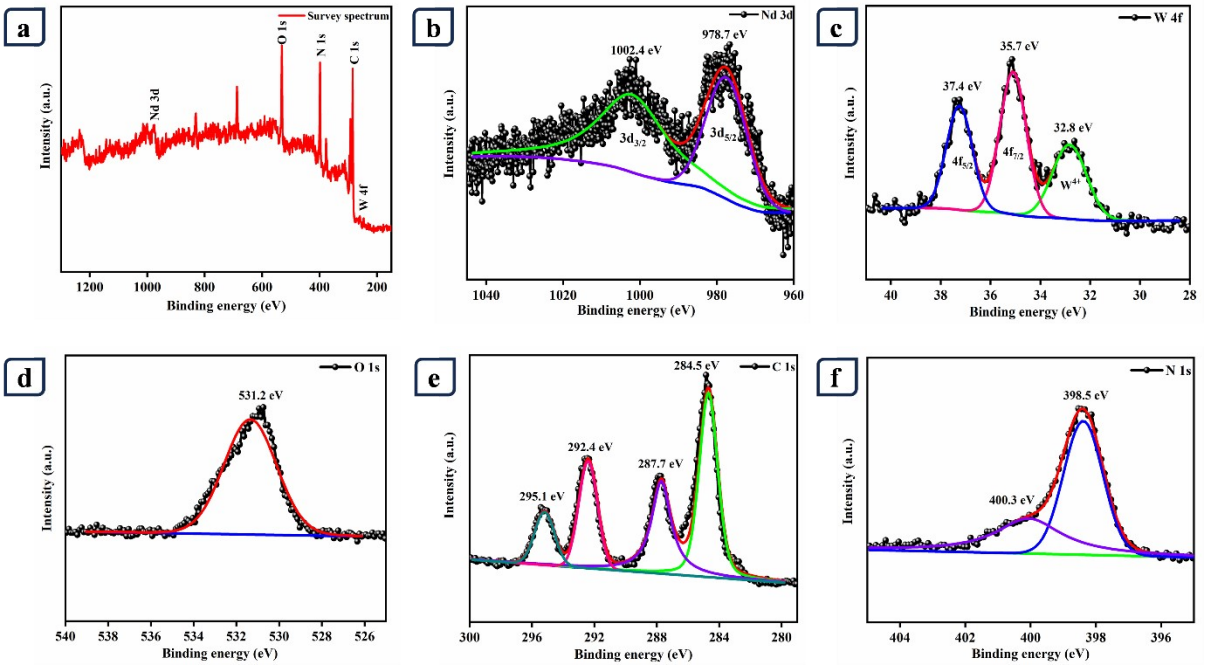

Fig.S9. XPS spectrum of GCN@NW achieved after stability (a) survey spectrum, (b) Nd 3d spectrum, (c) W 4f spectrum, (d) O 1s spectrum, (e) C 1s spectrum, and (f) N 1s spectrum.