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Effect of Carbon Nanotube and Graphene Oxide on the Electrocatalytic Behavior of Ni-W Alloy for Hydrogen Evolution Reaction

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Supplementary Information

1. Characterization of functionalized CNT

The CNT used in the present study was sourced from Sigma-Aldrich, St. Louis, Missouri, United States and functionalized using the chemical method as reported by Yang et al. [1]. Further, the functionalized MWCNTs were characterized using FTIR analysis (Bruker Alpha FTIR Spectrometer, Bruker Optic GmbH, Ettlingen, Germany) by scanning from wave number 500 – 4000 cm^{-1}. The identified peaks around 1361, 1712 and 3401 cm^{-1} are corresponding to C–O, C=O and O–H stretching, respectively [2, 3]. The peaks at 674, 1712 and 3401 confirms the introduction of carboxylic (COOH) functional group into the chemically modified MWCNTs as shown in Fig. S1.

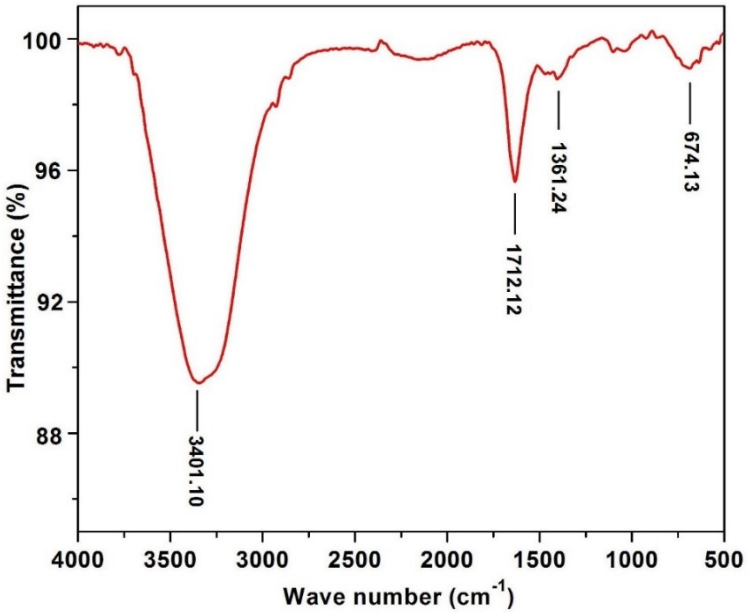

Fig. S1- FTIR spectrum of the acid treated MWCNTs showing characteristic peaks of generated functional groups confirm the surface modification after chemical oxidation

2. Characterization of the synthesized GO

The graphene oxide (GO) was synthesized using modified Hummer's method as reported by Su et al. [3]. The formation of GO after the chemical treatment of graphite was confirmed using various characterization techniques such as Raman spectroscopy (Bruker Senterra R200), X-ray diffraction (XRD, Rigaku Miniflex 600, with CuK_{λ} radiation as the X–ray source) and transmission electron microscopy (TEM, JEOL, JEM-2100).

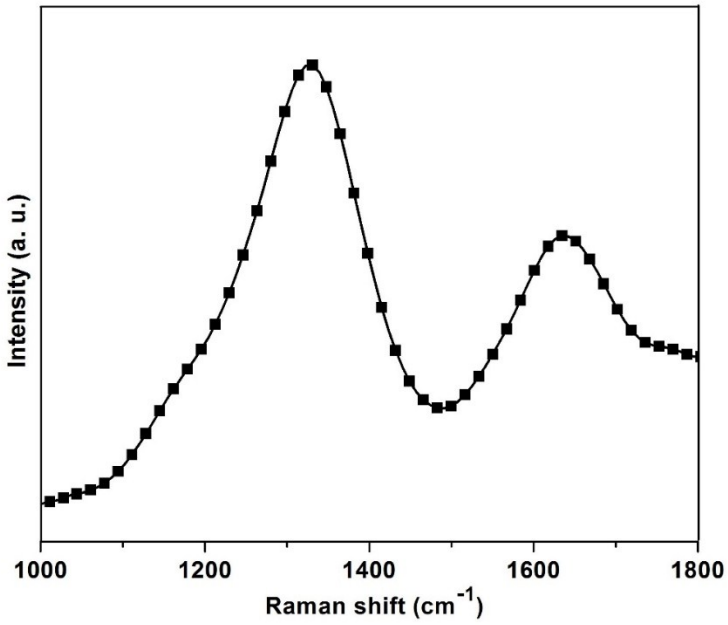

Fig. S2- Raman spectrum of the graphene oxide (GO) showing the two peaks at 1318 and 1610 cm^{-1}, characteristics of the D and G bands corresponds to E_{2g} phonon of sp^2 C atoms and carbon lattice defects, respectively

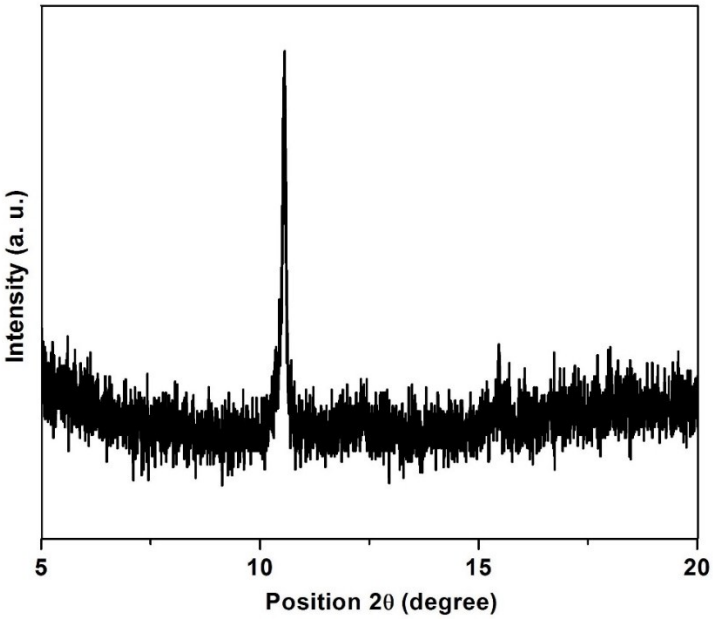

Fig. S3- XRD pattern of graphene oxide showing the presence of (101) reflection at 2θ = 10.4˚, with *d* spacing of 0.68 nm, due to the intercalation of oxygen confirms the formation of GO

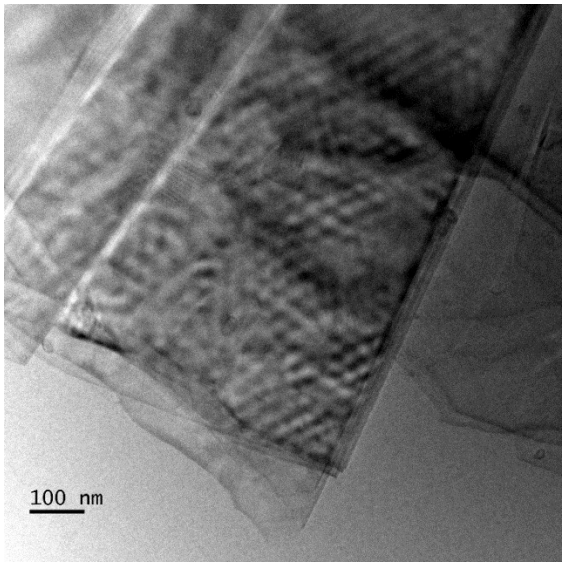

Fig. S4- TEM image clearly depicts the rippled and entangled GO nanosheets

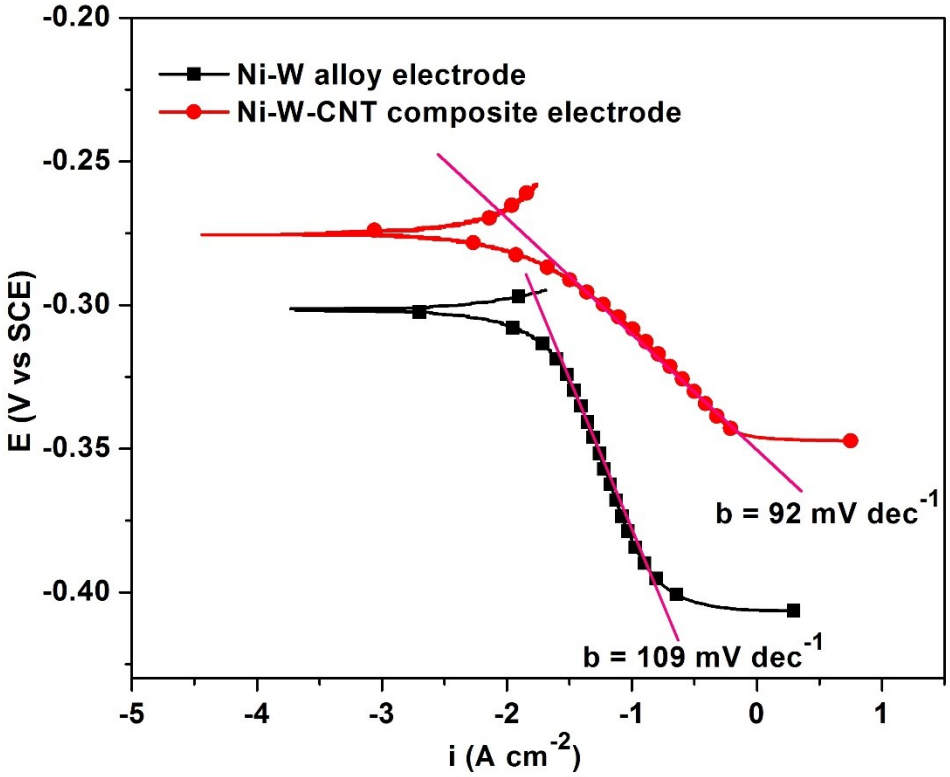

Fig. S5- Tafel polarization curves for the Ni-W alloy and Ni-W-CNT composite electrodes