Supplementary Information

Graphene-Coated Copper Nanowire Networks as a Highly Stable Transparent Electrode in Harsh Environments Toward Efficiently Electrocatalytic Hydrogen Evolution Reaction

Arunugam Manikandan†, Ling Lee†,⊥, Yi-Chung Wang†, Chia-Wei Chen†, Yu-Ze Chen†,
Henry Medina†,⊥, Jiun-Yi Tseng†,#, Zhiming M. Wang‡ and Yu-Lun Chueh†,⊥,‖,*

†Department of Material Science and Engineering, National Tsing Hua University, Hsinchu 30013, Taiwan, ROC

‡School of Material Science and Engineering, State Key Laboratory of Advanced Processing and Recycling of Non-ferrous Metals, Lanzhou University of Technology, Lanzhou City 730050, Gansu, P.R. China

⊥Institute of Fundamental and Frontier Sciences, University of Electronic Science and Technology of China, Chengdu 611731, P. R. China.

#Department of Physics, National Sun Yat-Sen University, Kaohsiung, 80424, Taiwan, ROC.

‖Graduate School of Material Science, National Yunlin University of Science and Technology, Yunlin 64002, Taiwan, ROC


*Corresponding author: ylchueh@mx.nthu.edu.tw
**Fig. S1** (a-d) OM images of graphene-coated Cu NWs at different growth temperatures.

**Fig. S2** (a) RAMAN spectra of a-carbon-coated Cu NWs grown at 300 °C (top) and graphene-coated Cu NWs grown at 500 °C (bottom), (b and c) HRTEM images of a-carbon coated Cu NW and (d and e) HRTEM image of graphene-coated Cu NW grown at 300 and 500 °C.
Fig. S3 (a) Rs Vs T% of a-carbon coated Cu NW TCE at 300 °C (b) photographic images of different concentration of samples.

Fig. S4 SEM images of Cu NWs TCE (a and b) and graphene-coated Cu NWs TCE (c and d) before and after oxidation tests at 240 °C in the presence O₂ gas of 300 sccm.
**Fig. S5** Rs vs Time plot of graphene-coated Cu NWs TCE after oxidized at 300 °C in the presence O₂ gas of 300 sccm.

**Fig. S6** SEM images of Cu NWs TCE (a and b) before and after basic tests in the presence of 0.5 M NaCl (c and d) before and after acidic tests in the presence of 0.5 M H₂SO₄, respectively.
**Fig. S7** SEM images of graphene-coated Cu NW TCE (a and b) before and after basic tests in the presence of 0.5 M NaCl (c and d) before and after acidic tests in the presence of 0.5 M H₂SO₄.

**Fig. S8** ICPMS results of the sea water collected from Penghu Island, Taiwan (concentration of element in ppb)
**Fig. S9** SEM images of Cu NW TCE (a & b) and graphene-coated Cu NW TCE (c & d) before and after sea water test.

**Fig. S10** (a) HRTEM images of graphene-coated Cu NWs grown at 400 °C. (b) and (c) show brunauer–emmett–teller (BET) measurements of Cu NWs and graphene-coated Cu NWs, respectively.
Fig. S11 Electrode kinetics of Cu NWs and graphene-coated Cu NWs by Nyquist plots.

Fig. S12 UPS plots of pure Cu NWs and graphene-coated Cu NWs.