Supporting Information

Enhanced Optical, Magnetic and Hydrogen Evolution Reaction Properties of Mo$_{1-x}$Ni$_x$S$_2$ Nanoflakes

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**Figure S1.** Cyclic voltammograms of (A) pristine MoS_2 and (B) 3% Ni-MoS_2 in a 0.5 M H_2SO_4 solution at different scan rates (10-100 mVs^{-1}). (C) Relations of difference between anodic and cathodic currents (ΔJ = J_a - J_c) at 0.2 V with various scan rates.

The C_{dl} can be calculated from the plot (C), where the slope of the ΔJ vs. scan rate curve is 2C_{dl}. The high C_{dl} value leads to larger electrochemical surface area and more active sites for better HER performance.
**Figure S2.** Low (a,c) and high (b,d) magnification SEM images of 3% Ni-MoS$_2$ film on GC before (a, b) and after (c, d) the durability measurements.

**Figure S3.** Raman spectra of 3% Ni-MoS$_2$ film on GC before and after the durability measurements.
Figure S4. LSVs of MoS$_2$ and 3% Ni-MoS$_2$ modified electrodes in (a) alkaline (1 M KOH) and in (b) neutral (0.5 M Na$_2$SO$_4$) electrolytes at 2 mV s$^{-1}$ scan rate.

Figure S5. Polarization curves showing the comparison of the 3% Ni-MoS$_2$ electrode with Pt wire (black) and graphite rod (red) as counter electrodes.
Table S1. Summary of the valuable parameters of the MoS$_2$ and various Mo$_{1-x}$Ni$_x$S$_2$ electrocatalysts in acidic medium.

| Samples     | Overpotential (at 1 mAcm$^{-2}$) (mV) | R$_{ct}$ (KΩ) | Tafel slope (mV/decade) | Exchange current density ($J_0$) (mAcm$^{-2}$) | C$_{dl}$ (mFcm$^{-2}$) |
|-------------|--------------------------------------|--------------|-------------------------|-----------------------------------------------|-----------------------|
| MoS$_2$     | 418                                  | 3.402        | 162                     | 2.2 x 10$^{-3}$                               | 3.7                   |
| 1% Ni-MoS$_2$ | 392                                  | 2.519        | 146                     | 3.2 x 10$^{-3}$                               | 5.5                   |
| 3% Ni-MoS$_2$ | 297                                  | 0.730        | 94                      | 8.5 x 10$^{-3}$                               | 8.2                   |
| 5% Ni-MoS$_2$ | 370                                  | 1.400        | 130                     | 4.6 x 10$^{-3}$                               | 7.6                   |