ADVANCED SUSTAINABLE SYSTEMS

Supporting Information

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MoS_2 Nanosheets Uniformly Anchored on $NiMoO_4$ Nanorods, a Highly Active Hierarchical Nanostructure Catalyst for Oxygen Evolution Reaction and Pseudo-Capacitors

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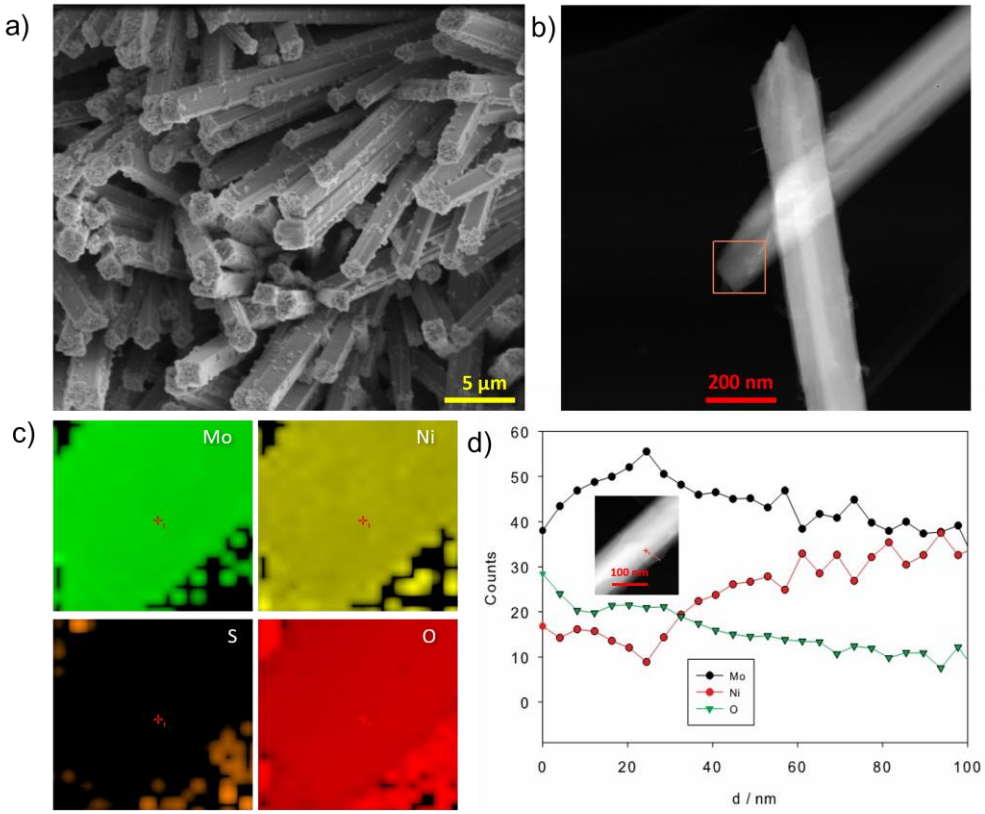

Figure S 1 a) SEM images $NiMoO_4$ / MoS_2 hierarchical structure, (b,c) EDS mapping for Mo, Ni, S, and O, and d) the EDS profile on the edge of $NiMoO_4$/ MoS_2 hierarchical structure showing Mo, Ni, and O signal. (the characterizations is for 7 min deposition of MoS_2, for comparison purpose)

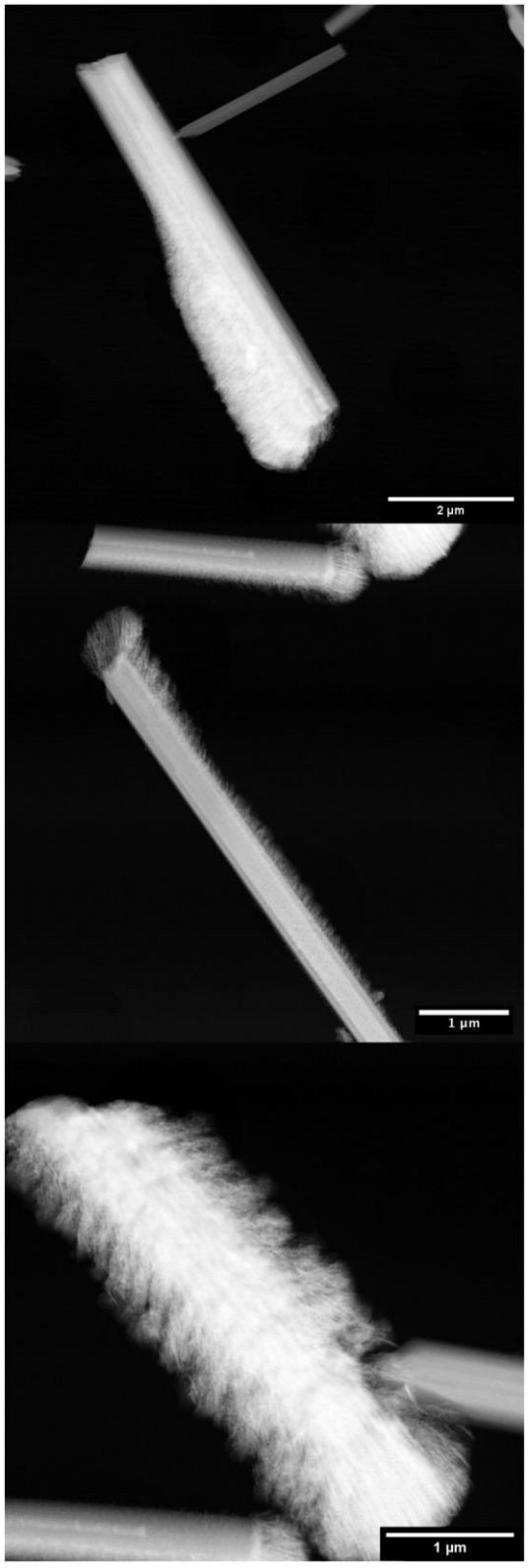

Figure S 2. STEM-HAAD micrographs of $NiMoO_4$ /MoS_2 heterostructured nanowires displaying various degrees of anisotropic decoration.

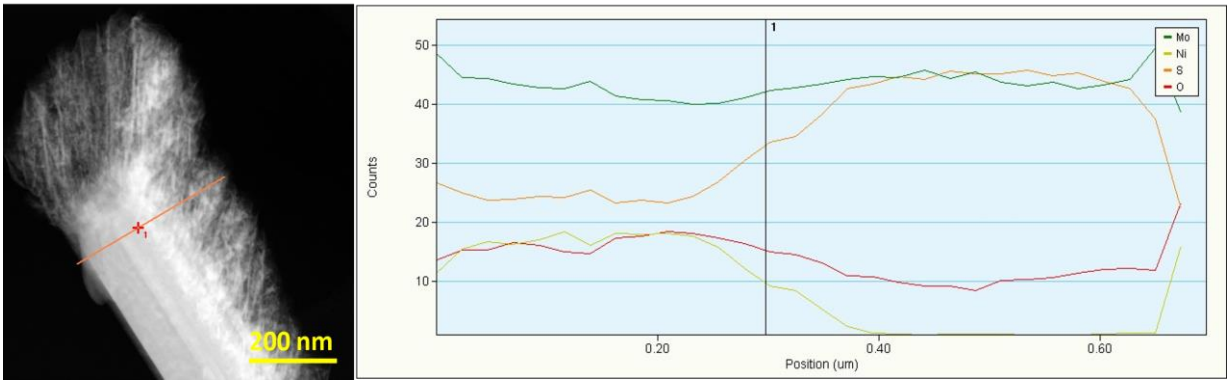

Figure S 3 The EDS profile on the edge of $NiMoO_4$/ MoS_2 hierarchical structure showing Mo, Ni, and O and S signal.

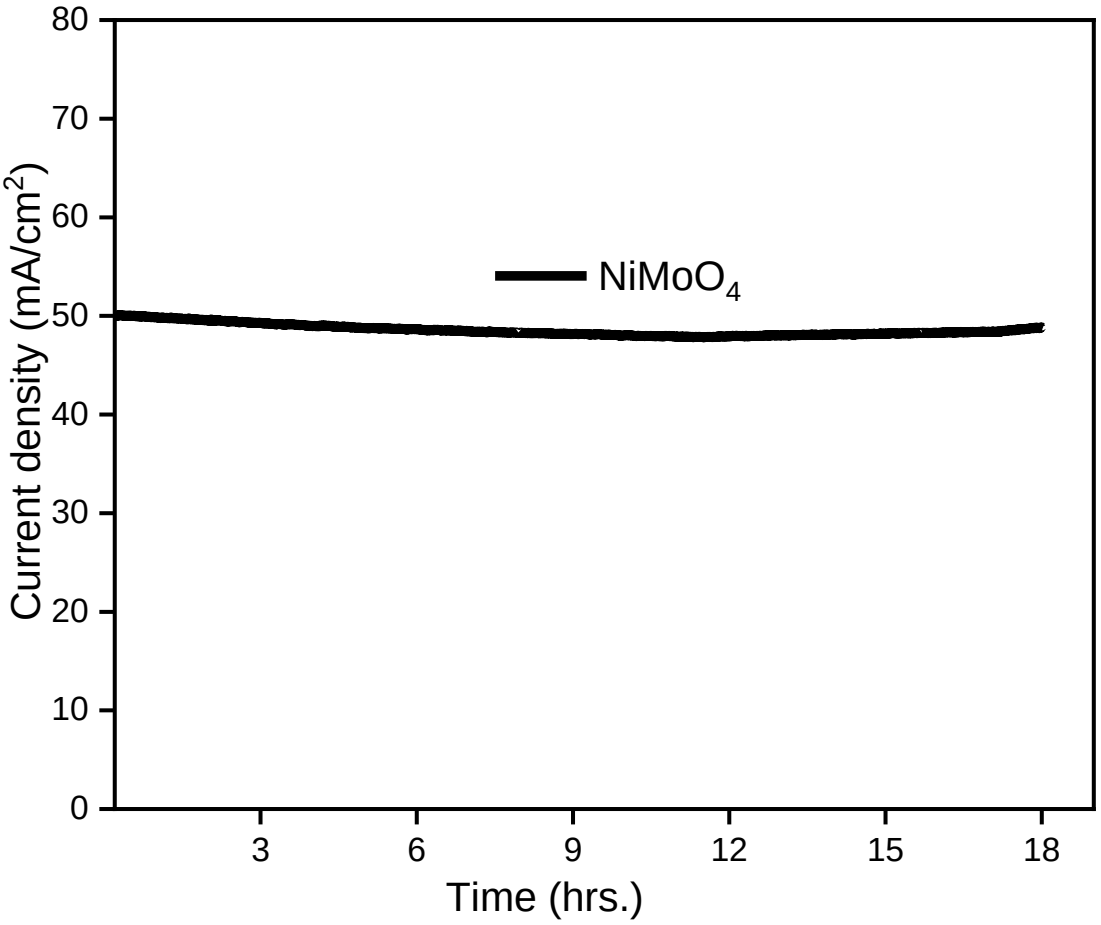

Figure S 4. Chronoamperometry measurement (stability test) for hydrated $NiMoO_4$.

The capacitance values have been calculated as [1,2]:

$$C = \left(Q(R_1)^{(1-a)}\right)^{1/a} \quad (1)$$

where R_1 is the solution resistance, Q is a fitting parameter of the CPE and α is the fitting exponent factor, which varies from 0 to 1. When α is approaching 0, the CPE behaves as a pure resistor, and when $\alpha = 1$ the CPE represents a pure capacitor. The result is compared in Table S1 below.

The Nyquist plots are fitted using the following equivalent circuit with help of RelaxIS 3.0.15.18 software. The corresponding fitting parameters are listed in the table below.

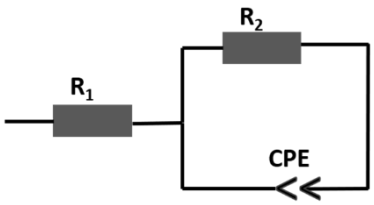

Table S1. Fitting parameters of simplified Randles cell.

Catalyst	R_S, Ω	$Q_{CPE,} \times 10^{-3}$	α	C, mF	R_{CT}, Ω
$NiMoO_4$/ MoS_2	1.72	16.4	0.58	1.24	10.9
$NiMoO_4$	1.72	6.6	0.68	0.8	14.4

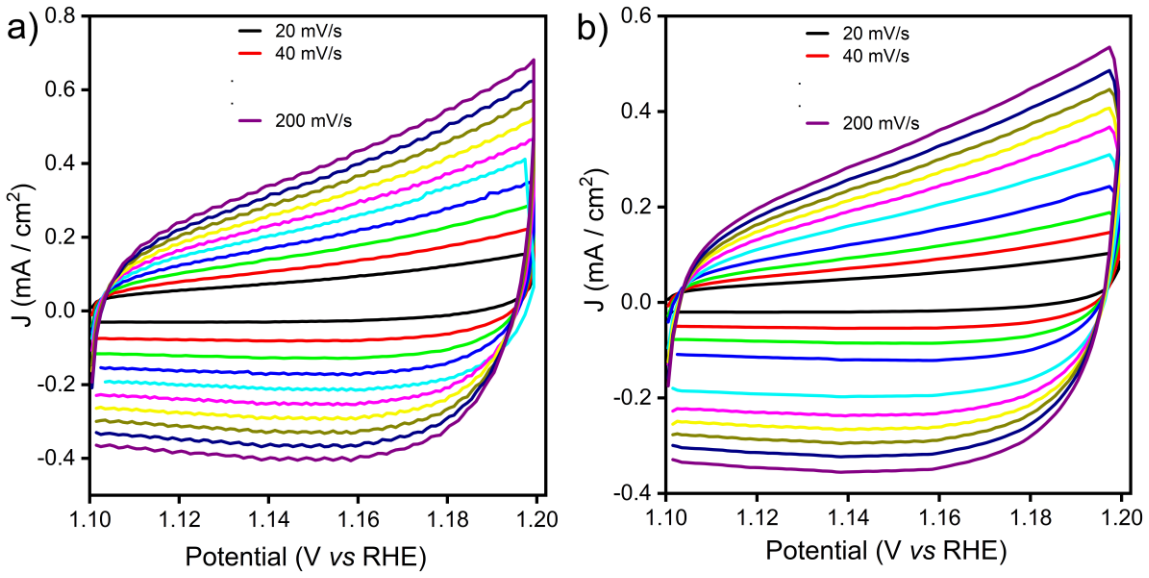

Figure S 5. Cyclic voltammetry for calculating double-layer capacitance a)$NiMoO_4$/MoS_2, b) $NiMoO_4$

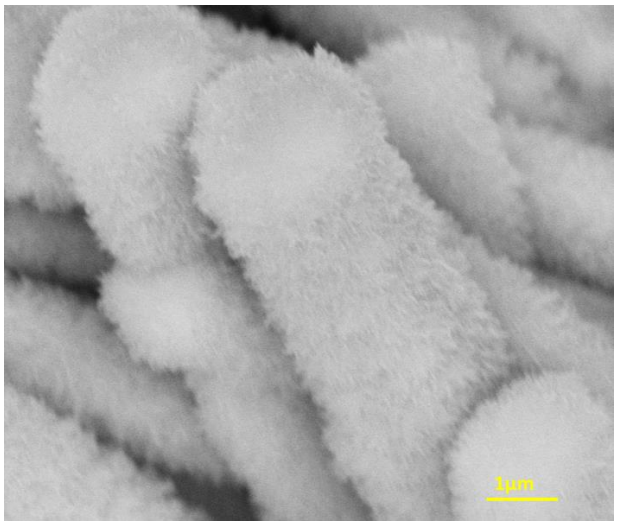

Figure S 6 . SEM images of $NiMoO_4/MoS_2$ after stability test.

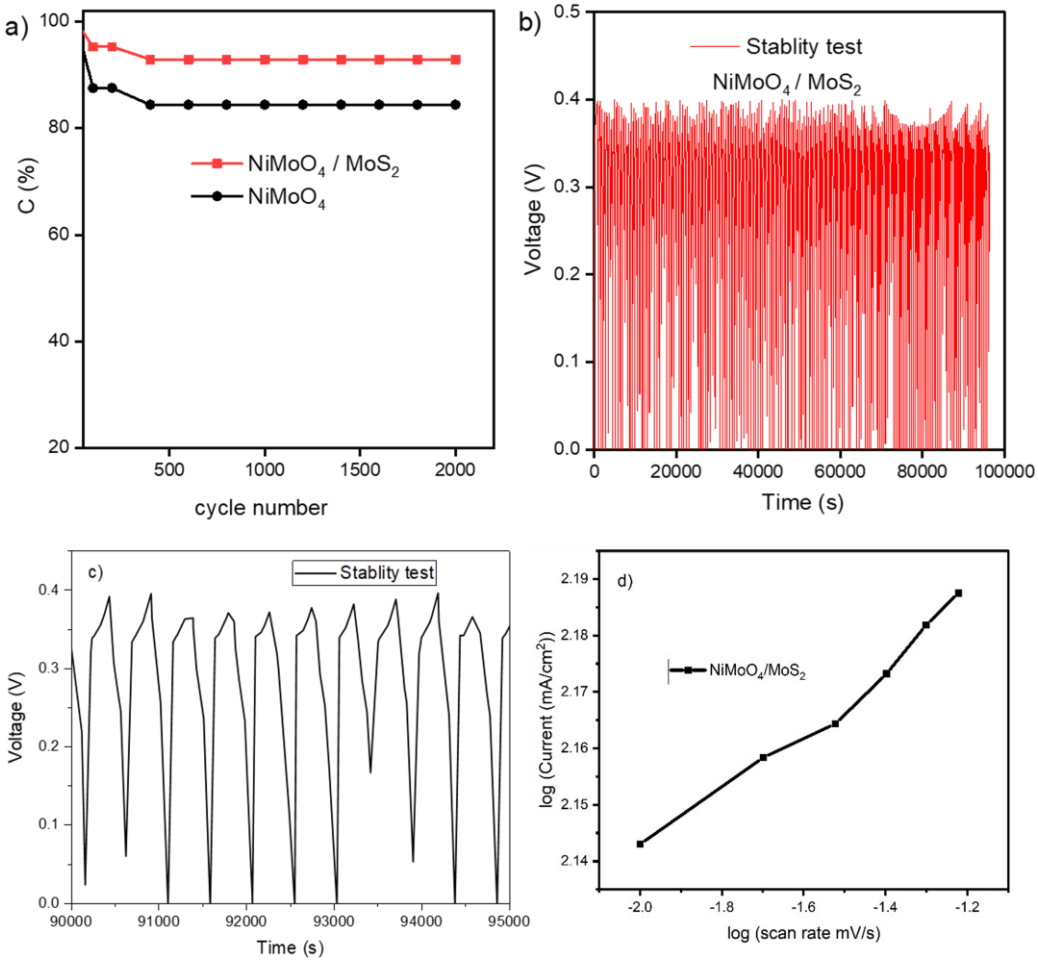

Figure S 7. a) Cycling durability test of $NiMoO_4$ /MoS_2 and $NiMoO_4$, b) all charge-discharge curves for $NiMoO_4$ /MoS_2 during 2000 cycling for durability test, and c) The last 10 charge-discharge curves and d) log i vs. log v plots of the cathodic peak of $NiMoO_4/MoS_2$

Reference

[1] V.D. Jović, B.M. Jović, EIS and differential capacitance measurements onto single crystal faces in different solutions: Part I - Ag(111) in 0.01 M NaCl, Journal of Electroanalytical Chemistry. 541 (2003) 1–11.

[2] G. Solomon, M.G. Kohan, M. Vagin, F. Rigoni, R. Mazzaro, M.M. Natile, S. You, V. Morandi, I. Concina, A. Vomiero, Decorating vertically aligned MoS2 nanoflakes with silver nanoparticles for inducing a bifunctional electrocatalyst towards oxygen evolution and oxygen reduction reaction, Nano Energy. 81 (2021) 105664.