3D self-supported porous vanadium-doped nickel nitride nanosheets arrays as efficient bifunctional electrocatalysts for urea electrolysis

Rui-Qing Li,*[a] Qi Liu,[a] Yanan Zhou,*[b] Mengjie Lu,[d] Jinle Hou,[a] Konggang Qu,[a] Yachao Zhu,*[c] and Olivier Fontaine [c]

[a] School of Chemistry and Chemical Engineering, Liaocheng University, Liaocheng 252059, P. R. China.

[b] School of Chemical Engineering, Sichuan University, Chengdu 610065, P. R. China.

[c] Institute Charles Gerhardt Montpellier, UMR 5253, CC 1502, Université Montpellier, Montpellier, France.

[d] Sino-Russian International Joint Laboratory for Clean Energy and Energy Conversion Technology, College of Physics, Jilin University, Changchun 130012, P. R. China.

* Corresponding author: liruiqing16@163.com; yananzhou@163.com; yachao.scu@hotmail.com

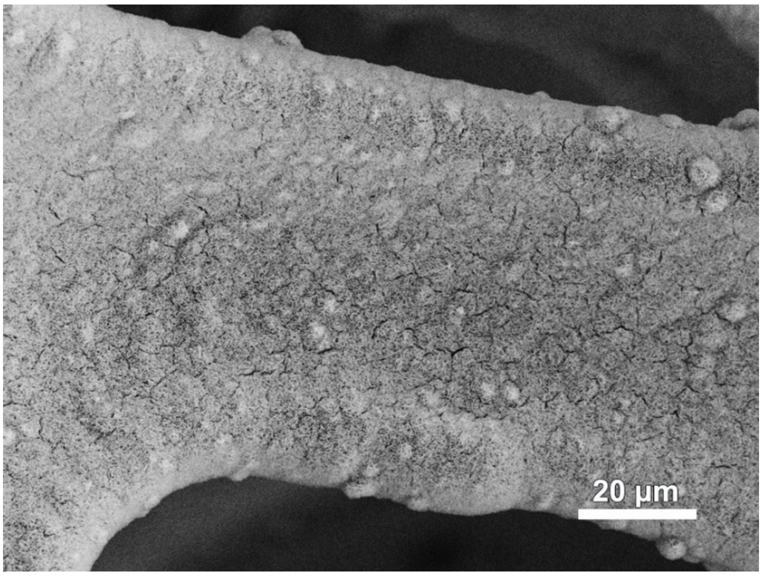

Fig. S1. SEM image of V-NiO/NF.

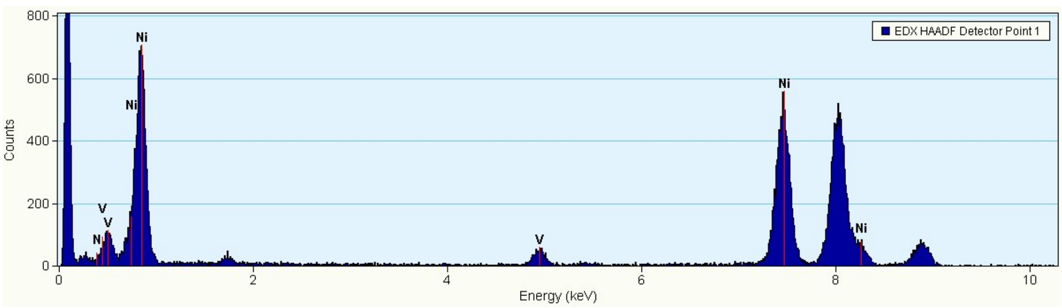

Fig. S2. EDX spectrum of V-Ni_3N/NF.

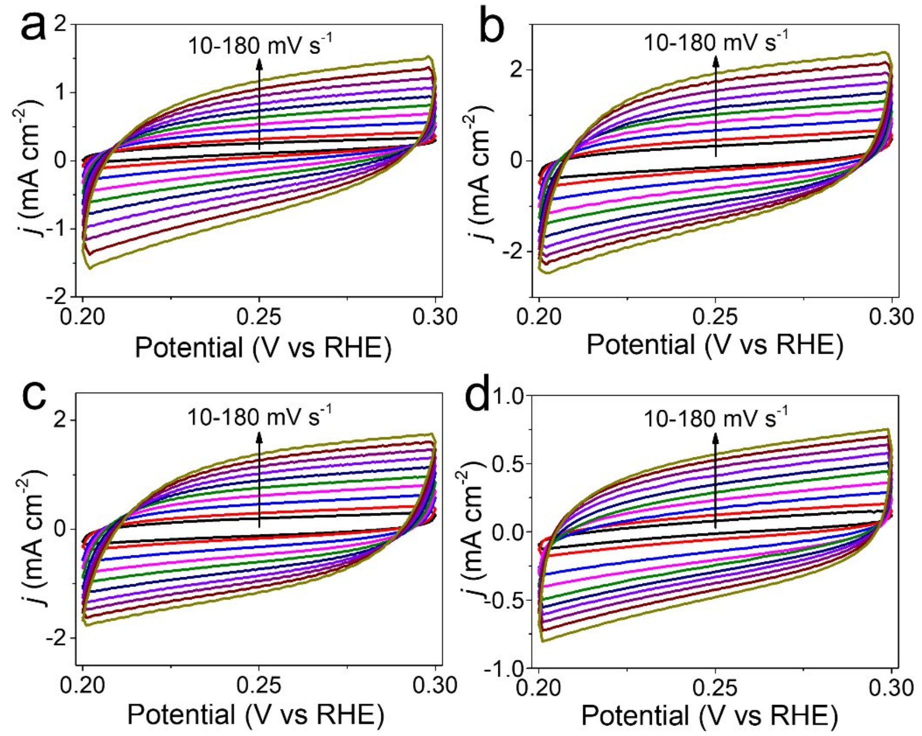

Fig. S3. Electrochemical cyclic voltammetry curves of (a) Ni_3N/NF, (b) V-Ni_3N/NF, (c) V-Ni_3N/NF-1, and (d) V-Ni_3N/NF-2 at different scan rates.

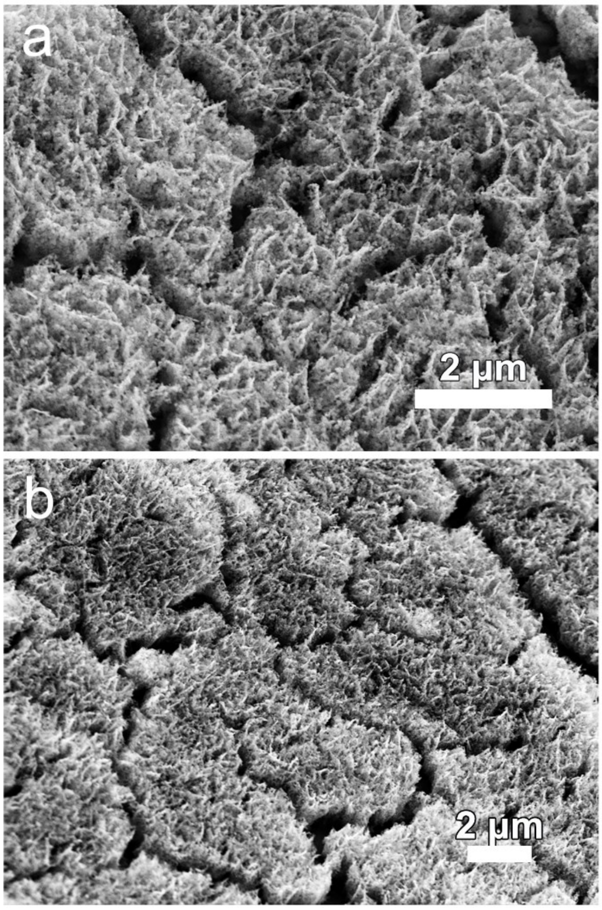

Fig. S4. SEM images of V-Ni_3N/NF after HER stability tests in 1M KOH (a) and 1M PBS (b) electrolyte.

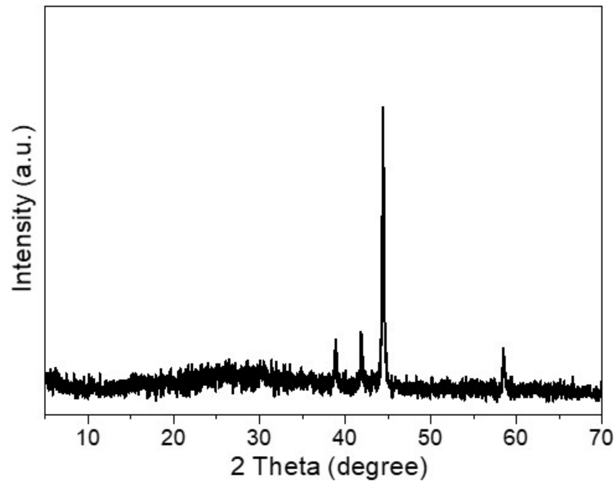

Fig. S5. XRD pattern of V-Ni_3N/NF after the HER stability test in 1M KOH electrolyte.

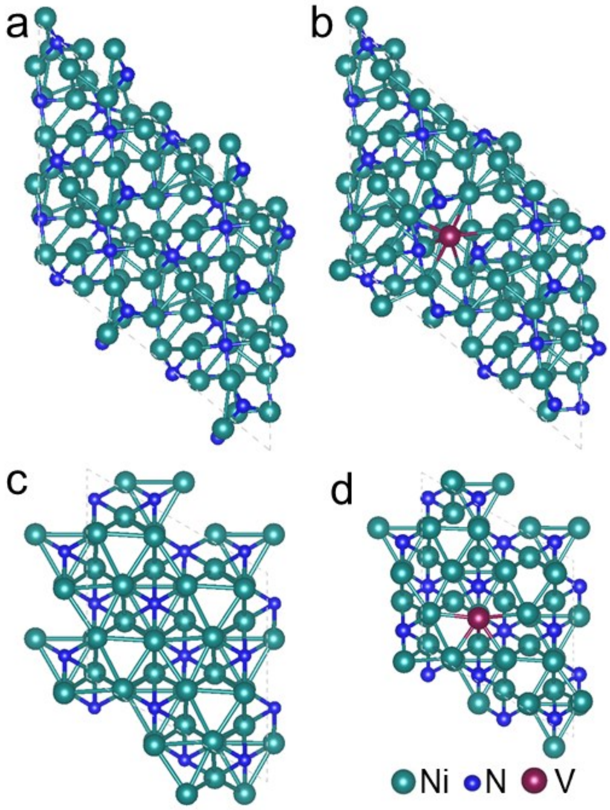

Fig. S6. The optimized structural models for (a) Ni_3N (111), (b) V-Ni_3N (111), (c) Ni_3N (002), and (d) V-Ni_3N (002).

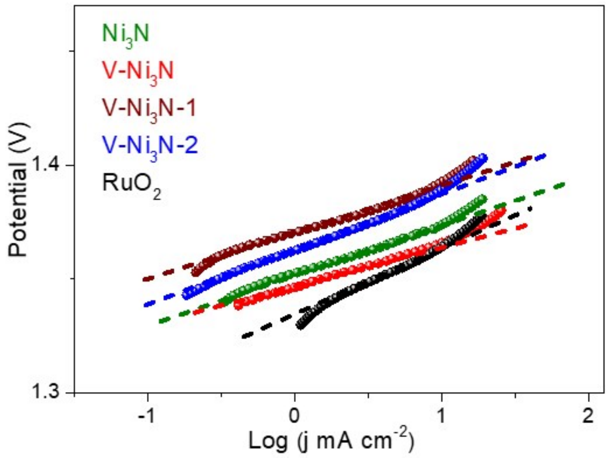

Fig. S7. Tafel slopes of UOR for different catalysts.

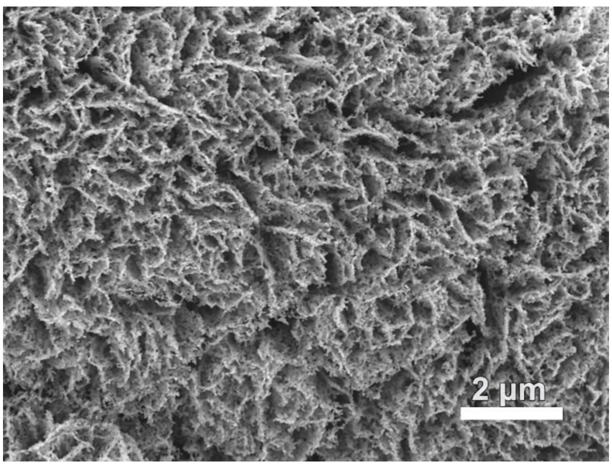

Fig. S8. SEM image of V-Ni_3N/NF after UOR stability test.

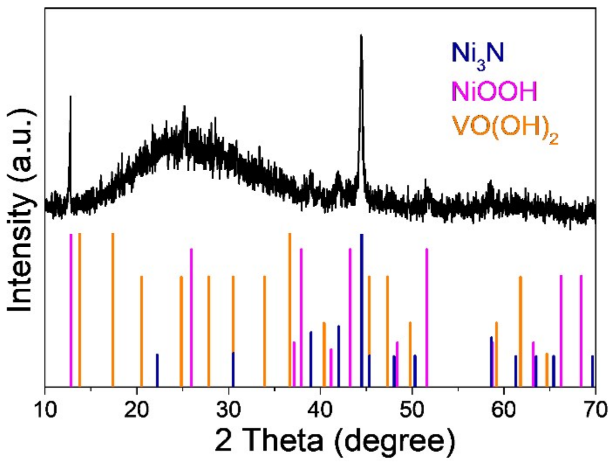

Fig. S9. XRD pattern of V-Ni_3N/NF after UOR stability test.

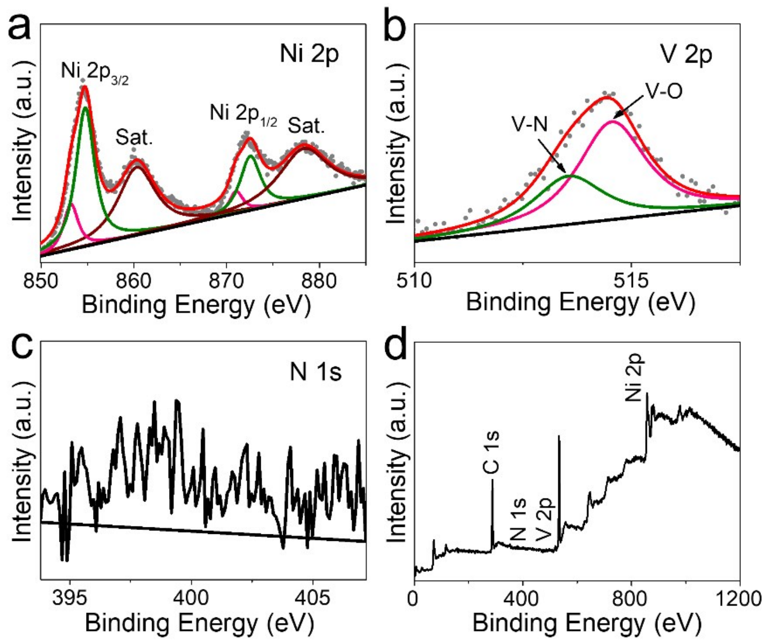

Fig. S10. XPS spectra of (a) Ni 2p, (b) V 2p, (c) N 1s, and (d) survey scan for V-Ni_3N/NF after UOR stability test.

Table S1 Comparison of the HER performance of V-Ni_3N/NF with other reported catalysts in alkaline electrolyte.

Catalysts	Overpotential (mV) at 10 mA cm^{-2}	Tafel slope (mV dec^{-1})	References
V-Ni_3N/NF	**83**	**45**	**This work**
Co-Ni_3N	194	156	[S1]
Ni_3FeN	94	90	[S2]
NiCoN/C	103	--	[S3]
NiCu-NiCuN	93	55	[S4]
Co_4N-$VN_{1-x}O_x$	118	73.6	[S5]
Mo_5N_6	94	66	[S6]
MoNiNC	110	65	[S7]
Fe-Ni_3S_2	105	69	[S8]
Mn-Co-P	86	52	[S9]

Table S2 Comparison of the UOR performance of V-Ni_3N/NF with other reported catalysts.

Catalysts	Potential (V) at 10 mA cm^{-2}	References
V-Ni_3N/NF	**1.361**	**This work**
Ni_2P	1.37	[S10]
MnO_2	1.37	[S11]
$Ni(OH)_2$	1.42	[S12]
NF-G-Mn	1.37	[S13]
NiMoO	1.37	[S14]
Ni_3Se_4	1.38	[S15]
MnO_2/$MnCo_2O_4$	1.43	[S16]
Pt/C	1.38	[S17]

Table S3 Comparison of the urea electrolysis performance of V-Ni_3N/NF with other recently reported catalysts.

Catalysts	Voltage (V) at 10 mA cm^{-2}	References
V-Ni_3N/NF	**1.416**	**This work**
Ni-Mo alloy	1.43	[S18]
CoMn/$CoMn_2O_4$	1.51	[S19]
Ni/C	1.6	[S20]
NiCoP	1.42	[S21]
MnO_2/$MnCo_2O_4$	1.58	[S22]
$NiCo_2S_4$	1.49	[S23]
Ni_2P/Fe_2P	1.47	[S24]
Fe-Ni_3S_2	1.46	[S25]
Pt/C	1.68	[S26]

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