Supporting Information

Energy storage and water splitting applications of self-grown Na_2O-$NiCl_2$ upright standing nanoplates: A process of 3D nickel surface modification using seawater

Sukhvinder kaur Sukhmani[a], Rajaram S. Mane[a*], Tabassum Siddiqui[a], Shoyebmohmad F. Shaikh[b], Sajjad Hussain[c]

[a]School of Physical Sciences, Swami Ramanand Teerth Marathwada University, Nanded 431606, Maharashtra, India

[b]Department of Chemistry, College of Science, King Saud University, Riyadh, 11451, Saudi Arabia

---

Formulae used:

The specific capacitance (C), energy density (E) and power density (P) were calculated from the discharge time of GCD curves using the equation as following

Specific capacitance,

$$C = \frac{I \times \Delta t}{m \times \Delta V} \quad (1)$$

Where, I is the discharge current, Δt is the discharge time, m is the mass of the active material and ΔV is the potential window.

The relation between energy density (E), power density (P) and specific capacitance (C_v) are calculated by the following equations:

Energy density,

$$E = \frac{1}{2} C \Delta V^2 \quad (2)$$

Power density,

$$P = \frac{E}{\Delta t} \times 3600 \quad (3)$$

In above formulae, C is the specific capacitance of Na_2O-$NiCl_2$@NiF//Na_2O-$NiCl_2$@NiF device, ΔV is the potential window (V) and Δt is the discharging time.

Measured potentials vs. SCE were converted to a reverse hydrogen electrode (RHE) using the Nernst equation.

$$E_{RHE} = E_{Ag/AgCl} + 0.059 \times PH + E^0{}_{Ag/AgCl} \quad (4)$$

Where E_{RHE} is the converted potential versus RHE, $E^0{}_{Ag/AgCl} = 0.197$ at room temperature and $E_{Ag/AgCl}$ is the experimental calculated potential versus an Ag/AgCl as a reference electrode. The over potential (η) can be calculated using the following equation [S1].

$$\eta = E_{RHE} - 1.23 \quad (5)$$

Where η and E_{RHE} are the over and converted potentials, respectively.

Table S1: A comparative analysis of morphology, synthesis method and the electrochemical energy storage performance by natural-eco-friendly aspects.

Sr. no	Working electrode	Synthesis method	Use of Natural resource	Morphology	Areal/Specific Capacitance ($F.cm^{-2}$/ $F.g^{-1}$)	Ref.
1	Carbon@NiF	Spray-pyrolysis	Coconut water	Nanosheets	782.7 F/g	S2
2	$Ti_3C_3T_x$, MXene	HF-etching	Sea water (electrolyte)	Nano-flakes	121.8 F/cm^2	S3
3	Carbon	Chemical activation	Almond	Nano-sheets	228 F/g	S4
4	Porous Carbon	Annealing and drying	Soyabean milk	Porous nanoparticles	118 F/g	S5
5	Fe_2O_3	Electro-deposition	Sea water (electrolyte)	Nanosheets	259.5 C/g	S6
6	Hard carbon (Cathode)	Electro-chemical cell	Sea water (Anode)	Hard nano-particles	-	S7

7	Carbon	Pyrolysis	Orange peel (Precursor)	Hollow Structured	407 F/g	S8
8	***Na_2O-$NiCl_2$@NiF***	***Hydrothermal***	***Sea water (Precursor)***	***Nano-plates***	***2533 F/g***	***Present work***

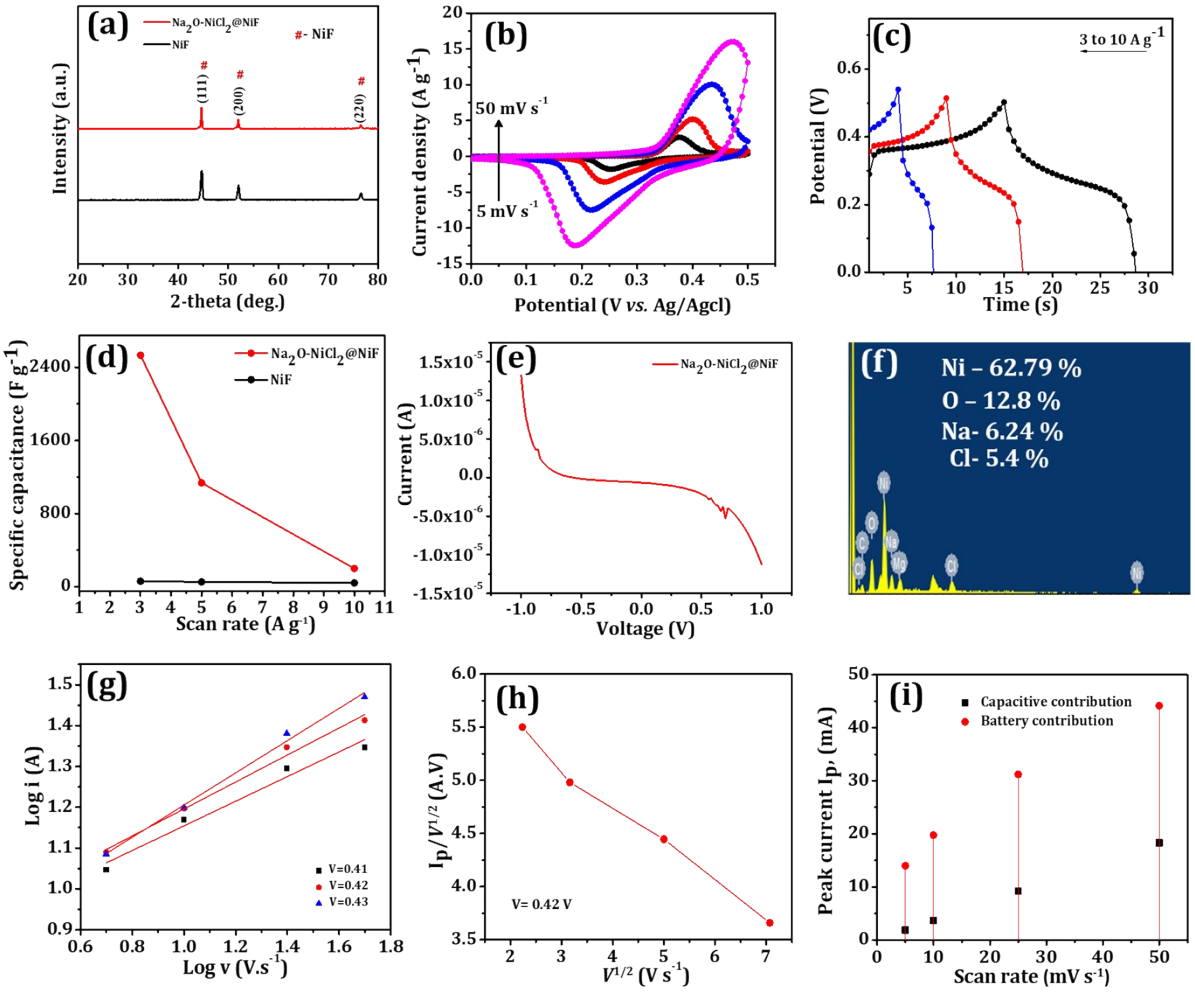

Figure S1: (a) XRD analysis (With bare NiF), (b) CV and (b) GCD curve of bare NiF, (d) Specific capacitance vs. scan rate plot, (e) Conductivity of sea water precursor (f) EDX elemental composition measurements Na_2O-$NiCl_2$@NiF, **(g)** log *i* vs. log *v* plots were used for obtaining '*b*', **(h)** $i/v^{1/2}$ *vs.* $v^{1/2}$ plots are used for estimating a1 and a2 (at 0.42 V), **(i)** capacitive and battery shares in overall performance.

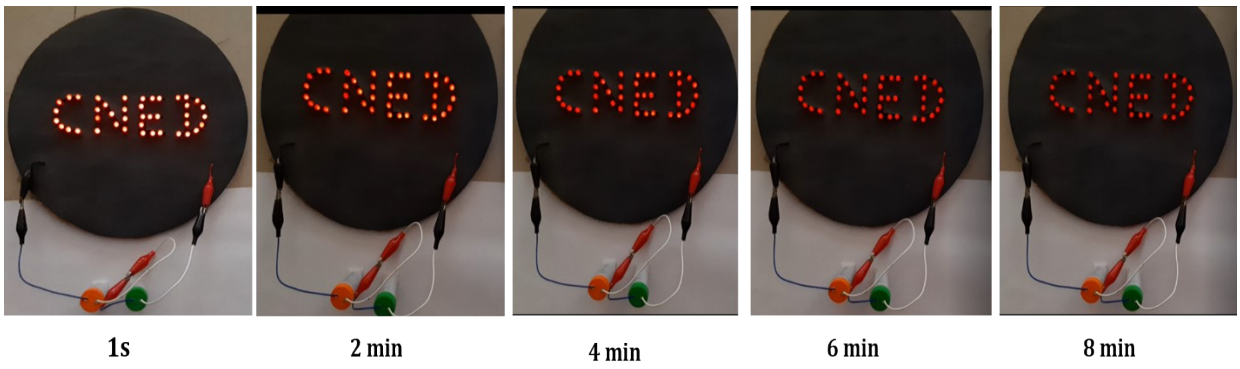

Figure S2: Digital photograph of Na_2O-$NiCl_2$@NiF// Na_2O-$NiCl_2$@NiF symmetric device practical demonstration.

References

[S1] W. Chen, H. Zhang, Z. Ma, S. Li, Z. Li, *J. Alloys Compd*., 2018, **762,** 565–573.

[S2] Y T. Nakate, U. T. Nakate, R.S. Mane, D. J. Shirale, *Coll. Surf. A: Phys. Engi. Asp*., 2021, **626**, 127012

[S3] Q. Xia, N. M. Shinde, T. Zhang, J. Yun, A. Zhou, R. S. Mane, S. Mathur, K. H. Kim, *Dalton Trans*., 2018, 01375.

[S4] F. Zeng, Z. Li, X. Li, J. Wang, Z. Kong, Y. Sun, Z. Liu, H Feng, *Appl. Surf. Sci*., 2019, **467-468**, 229-235.

[S5] L. Yang, J. Wang, S. Wang, X. Guan, X. Guan, G. Wang, *Springer,* 2019, **20**, 11589.

[S6] P. Zhao,M. Yao, Q. Zhang, N. Wang, W. Hu, S. Komarneni, *Electrochimica Acta,* 2019, 318, 211-219.

[S7] Y. Kim, J. Kim, C. Vaalma, G. Hyeong Bae, G. Kim, S. Passerini, Y. Kim, j.carbon, 2017, **12**, 059.

[S8] C. K. Ranaweera , P. K. Kahol, M. Ghimire, S. R. Mishra, R. Gupta, J. carbon, 2017**, 3**, 25.