Electronic Supplementary Material (ESI) for RSC Advances.


**Supporting Information**

# 3D hierarchical cobalt vanadate nanosheet arrays on Ni foam coupled with redox additive for enhanced supercapacitor performance

Van Thanh Nguyen[1], Fitri Nur Indah Sari[1], Jyh-Ming Ting[1,2*]

[1]Department of materials Science and engineering

[2]Hierarchical Green-Energy Materials (Hi-GEM) Research Center

National Cheng Kung University, Tainan 70101, Taiwan

[*] Corresponding author: jting@mail.ncku.edu.tw

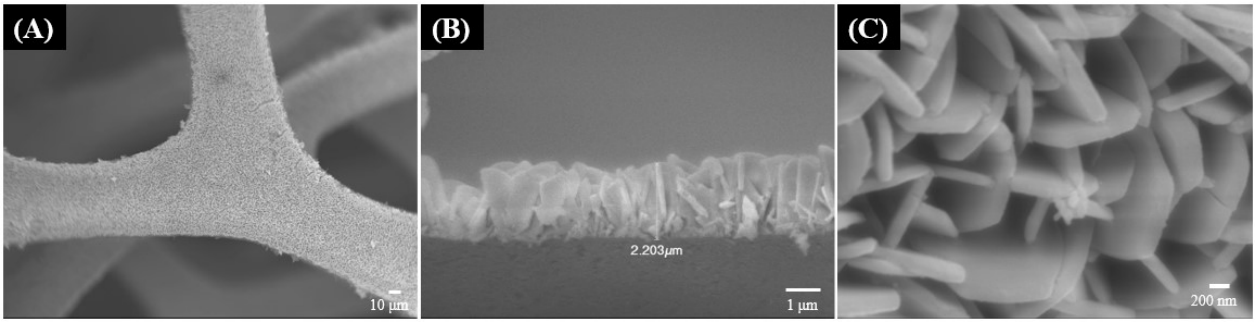



Figure S1. SEM images of ZIF-67@NF at different magnifications: (A) x 350, (B) x 10,000 and (C) x 30,000. The average thickness of the plates is approximately 180 nm.

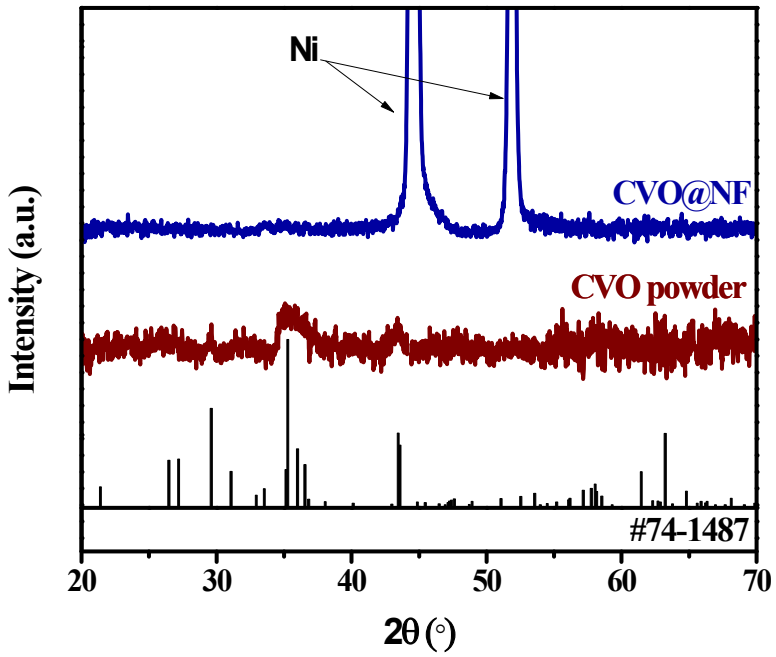
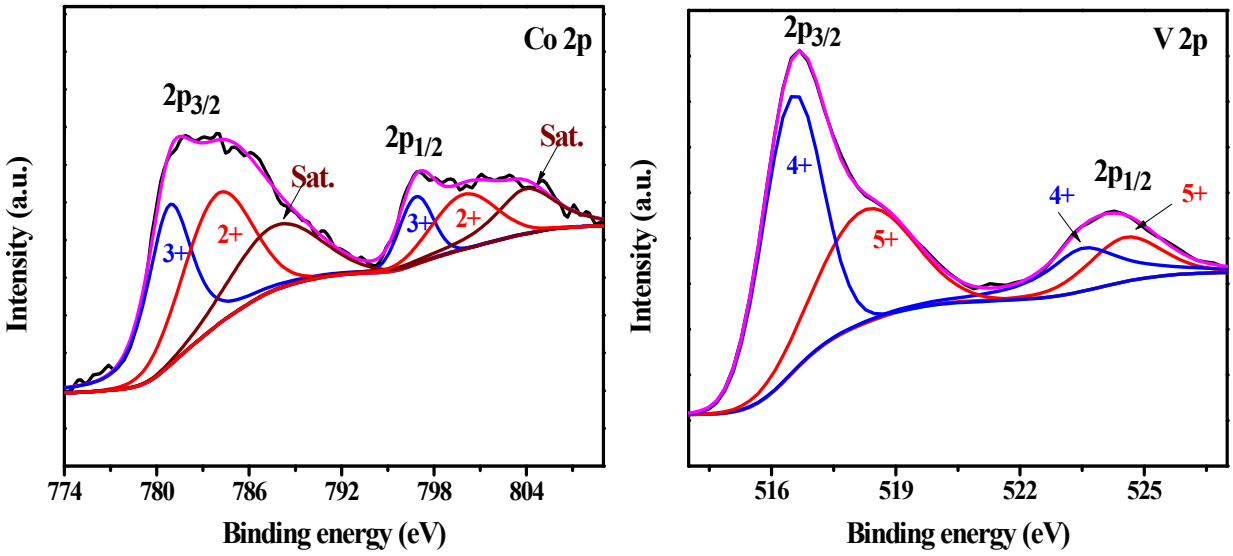



Figure S2. XRD patterns of (A) $Co_3V_2O_8$@NF and (B) $Co_3V_2O_8$ free standing powders.

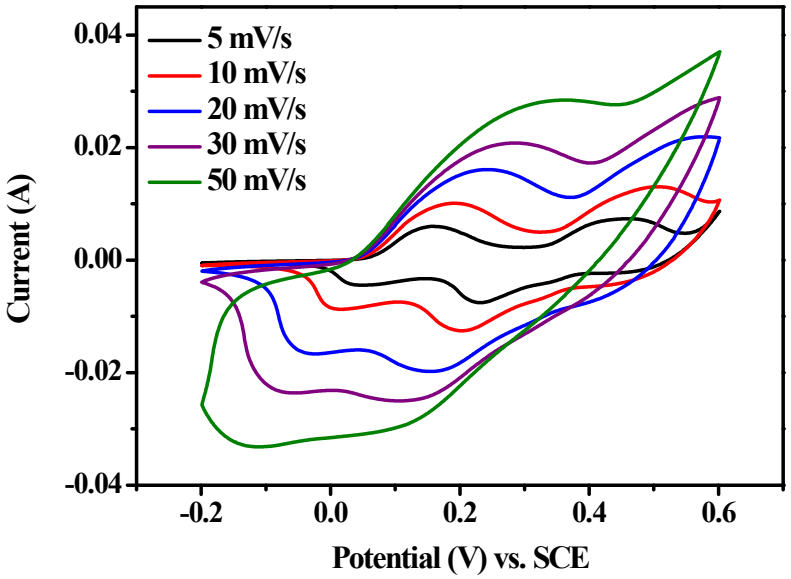
When deposited on Ni foam (NF), the XRD is absorbed by the Ni and little signal from the $Co_3V_2O_8$ can be collected, as shown in A. Using free standing powders, XRD pattern shows the formation of $Co_3V_2O_8$ with low crystallinity (B).



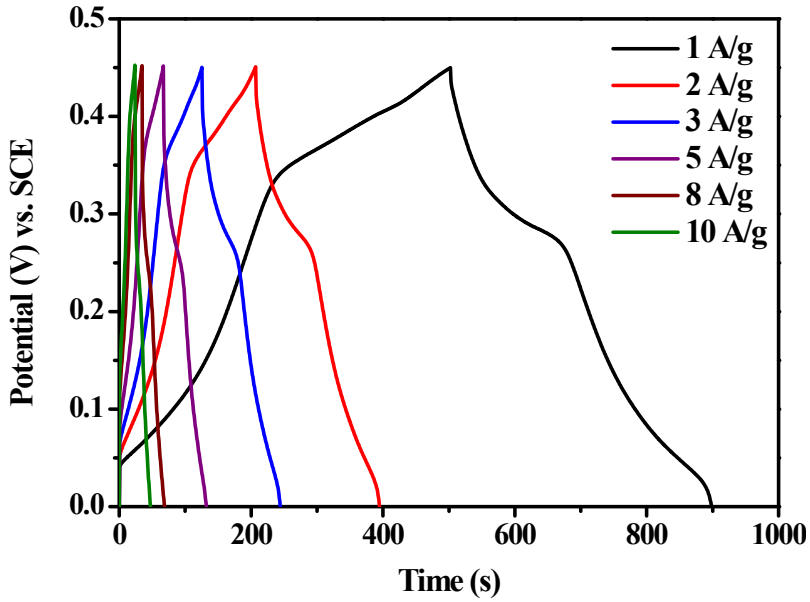

(A) (B)

Figure S3. XPS detailed (A) Co 2p and (B) V 2p spectra of CVO@NF.

In the high-resolution Co 2p spectrum (A), binding energy at 780.9, 784.3, 796.9, and 800.4 eV are ascribed to $Co^{3+}$ $2p_{3/2}$, $Co^{2+}$ $2p_{3/2}$, $Co^{3+}$ $2p_{1/2}$, and $Co^{2+}$ $2p_{1/2}$, respectively [1]. For the V 2p detailed spectra (B), there are $V^{4+}$ and $V^{5+}$ on the surface [1].




(A)




(B)

Figure S4. (A) CV curves at different scan rates and (B) GCD curves at different current densities. The electrolyte is 3 M KOH.

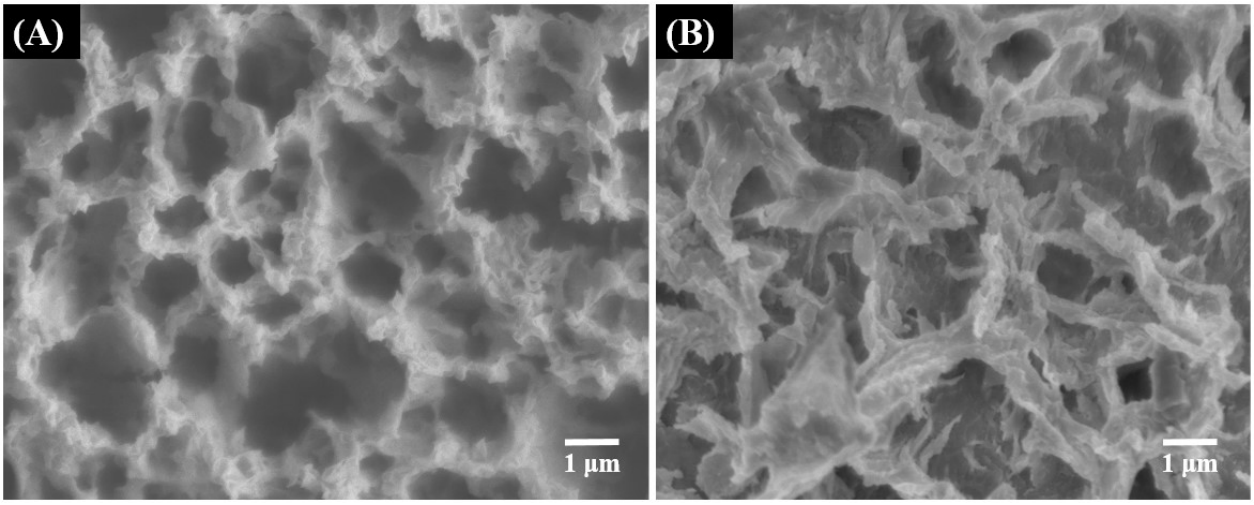
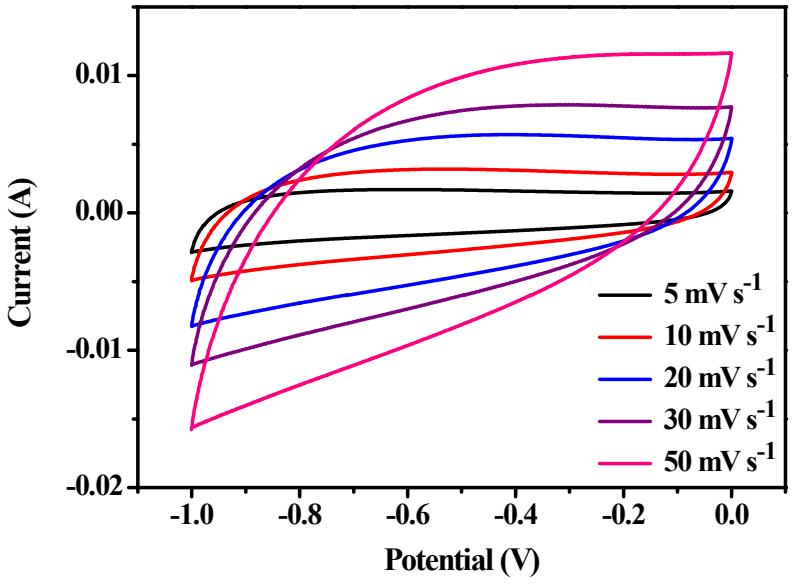
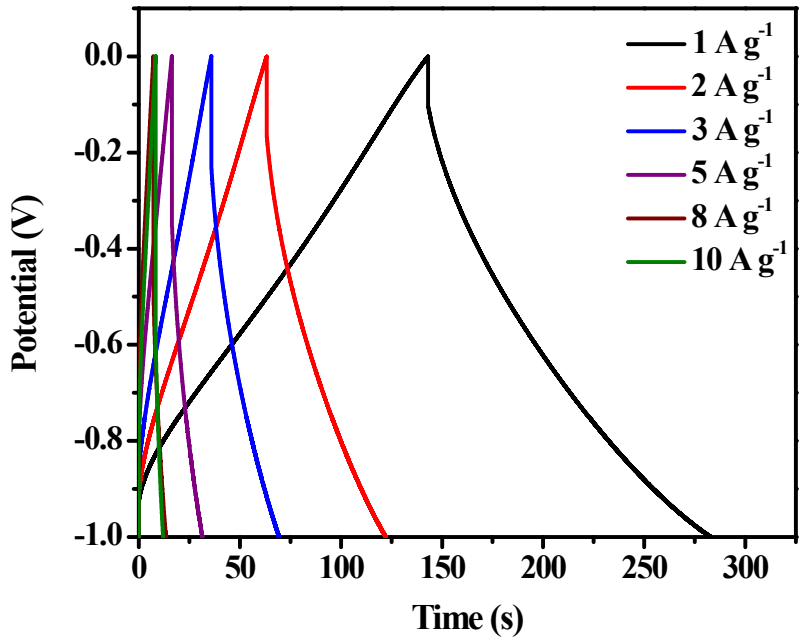


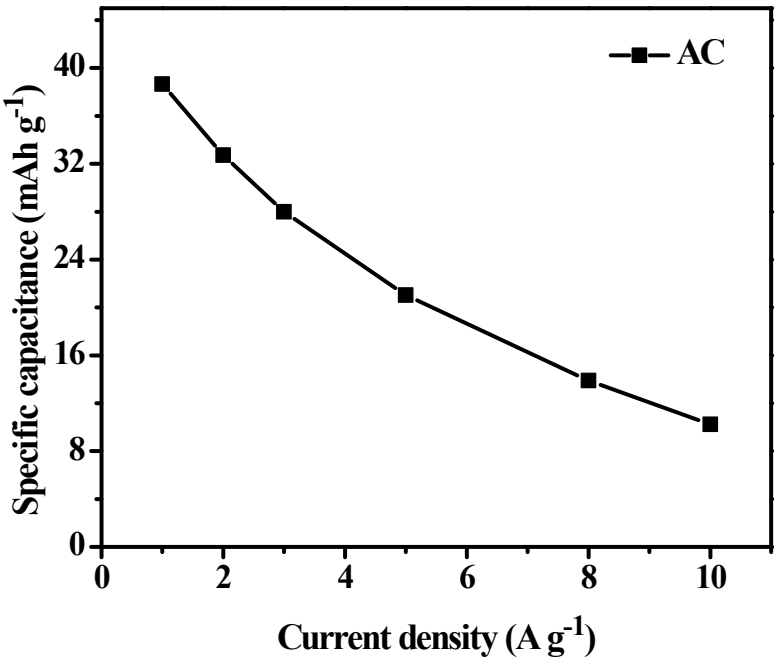

Figure S5. SEM images of $Co_3V_2O_8$ electrode after 5000 cycles testing in (A) KOH and (B) RA electrolytes.


0.01
0.00
-0.01
-0.02
Current (A)
-1.0
-0.8
-0.6
-0.4
-0.2
0.0
Potential (V)
5 mV s-1
10 mV s-1
20 mV s-1
30 mV s-1
50 mV s-1

(A)

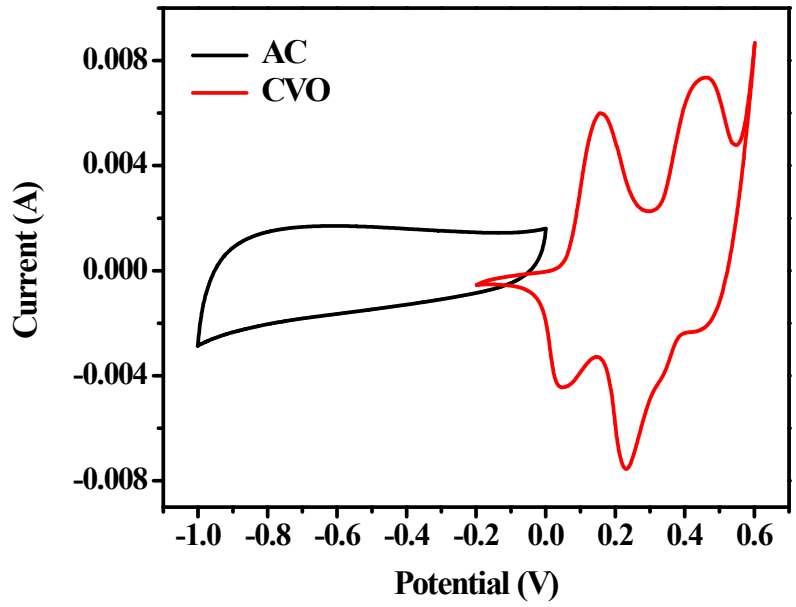

0.0
-0.2
-0.4
-0.6
-0.8
-1.0
Potential (V)
0
50
100
150
200
250
300
Time (s)
1 A g-1
2 A g-1
3 A g-1
5 A g-1
8 A g-1
10 A g-1

(B)

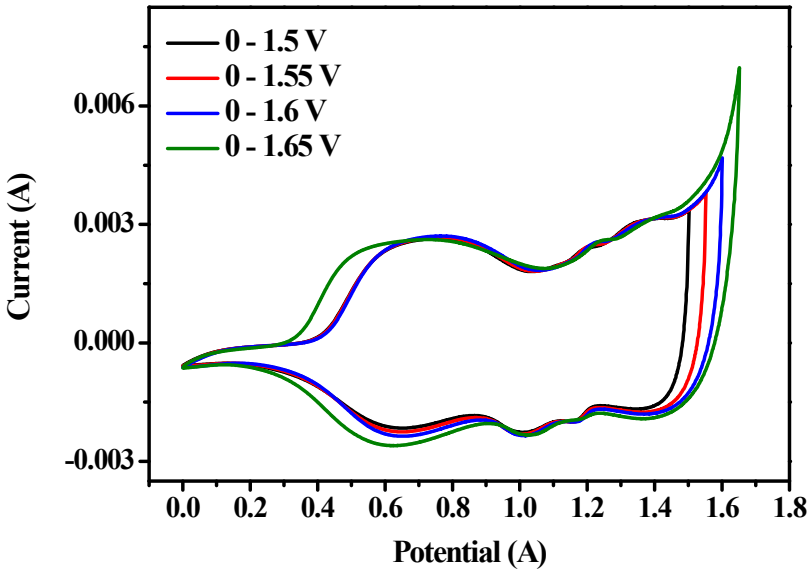



(C)

Figure S6. (A) CV and (B) GCD curves of the AC electrode, and (C) Csp of the AC electrode measured using KOH electrolyte.

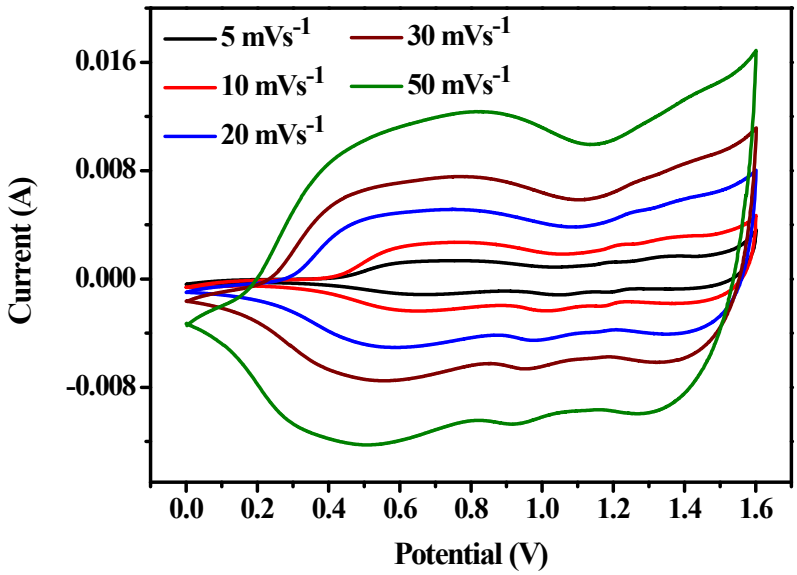



(A)

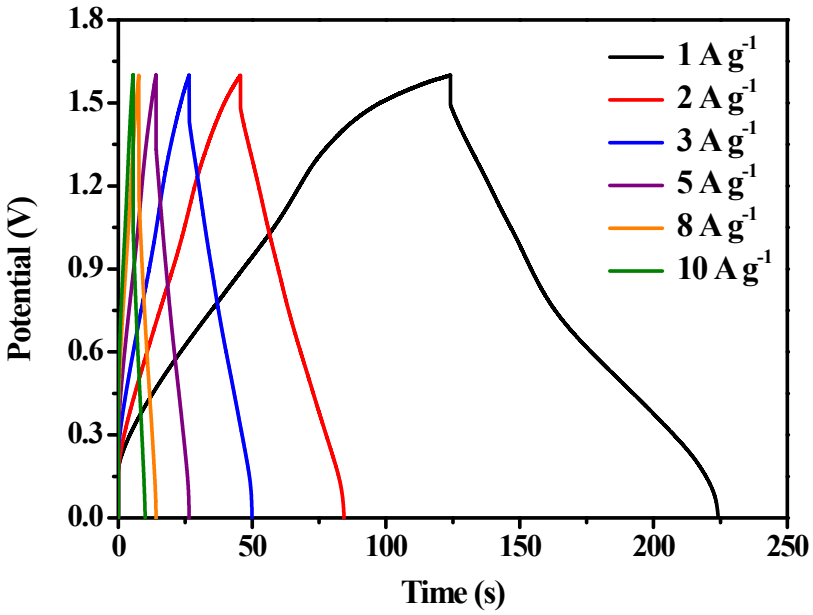



(B)

Figure S7. (A) CV curves of the positive and negative electrodes at 5 mV $s^{-1}$ in 3 M KOH. (B) CV curves of the ASCs obtained at different potentials.




(A)




(B)

Figure S8. (A) CV and (B) GCD curves of CVO//AC ASC measured in electrolyte of 3 M KOH.

**Reference**

[1] H. Sun, X. Chen, H. Chai, Y. Wang, D. Jia, Y. Cao, A. Liu, 3D porous hydrated cobalt pyrovanadate microflowers with excellent cycling stability as cathode materials for asymmetric supercapacitor, Appl Surf Sci 469 (2019) 118-124.