Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.


# Anionic Vacancy-dependent Activity of $CoSe_2$ with Tunable Interfacial Electronic Structure on N-doped Carbon Cloth Endowing Advanced Li-$O_2$ Battery

Zhiqian Hou[a,b], Chaozhu Shu[a]*, Ruixin Zheng[a], Chunhai Liu[a], Zhiqun Ran[a], Tingshuai Yang[a], Peng Hei[a], Qiang Zhang[a], Jianping Long[a]*

a. College of Materials and Chemistry & Chemical Engineering, Chengdu University of Technology, 1#, Dongsanlu, Erxianqiao, Chengdu 610059, Sichuan, P. R. China.

b. State Key Lab of High Performance Ceramics and Superfine microstructure, Shanghai Institute of Ceramics, Chinese Academy of Sciences, 1295 Dingxi Road, 200050 Shanghai, People's Republic of China.

Email: czshu@imr.ac.cn (Chaozhu Shu); longjianping@cdut.cn (Jianping Long)

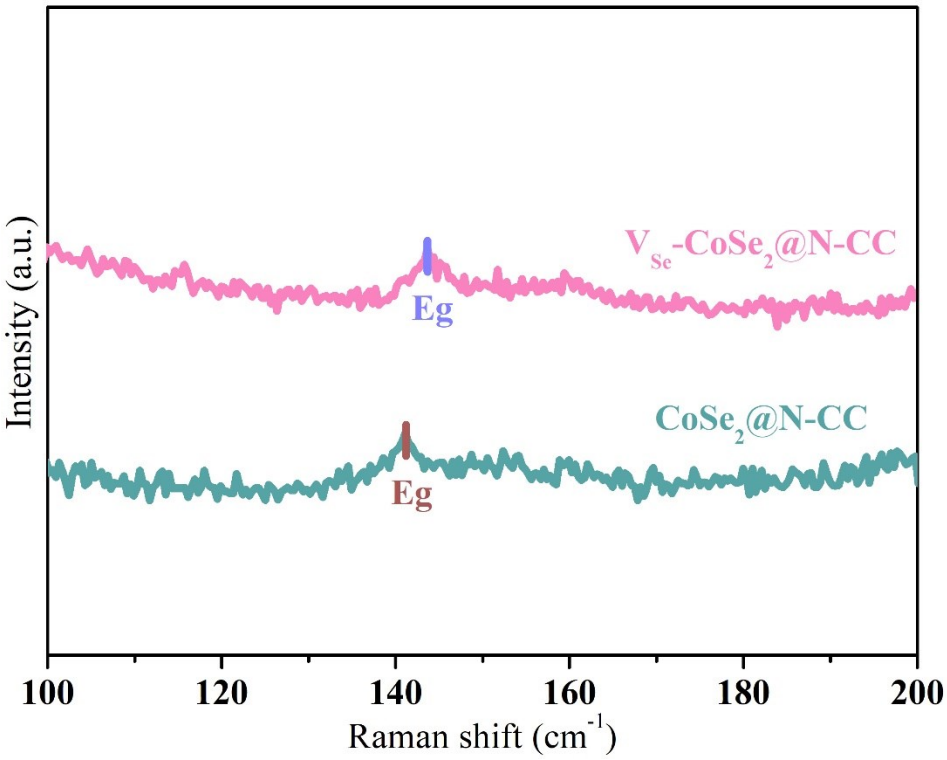


**Figure S1.** Raman spectra of $CoSe_2$@N-CC and $V_{Se}$-$CoSe_2$@N-CC.

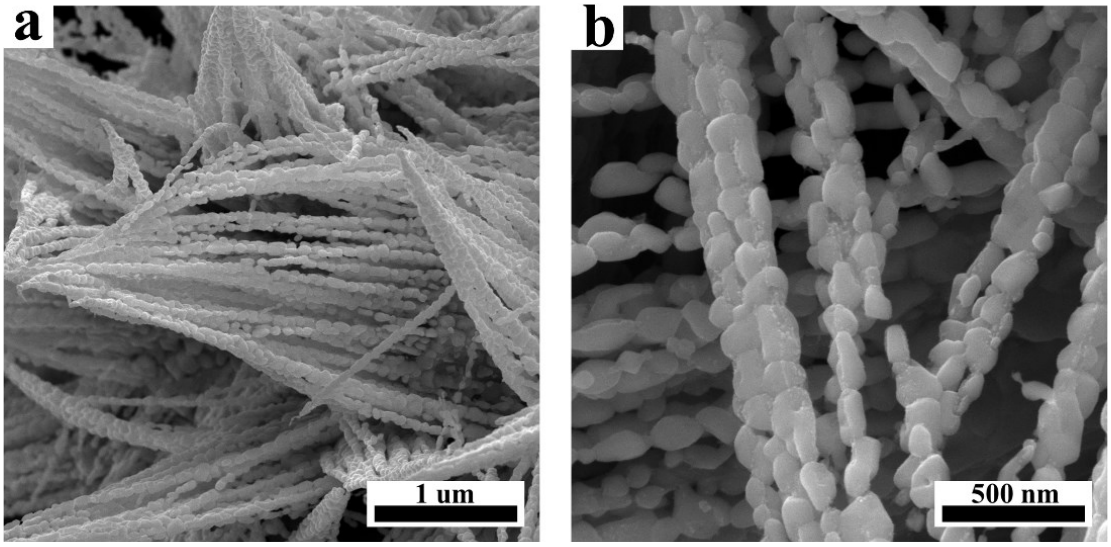


**Figure S2.** (a) and (b) FESEM images of the $CoSe_2$@N-CC.

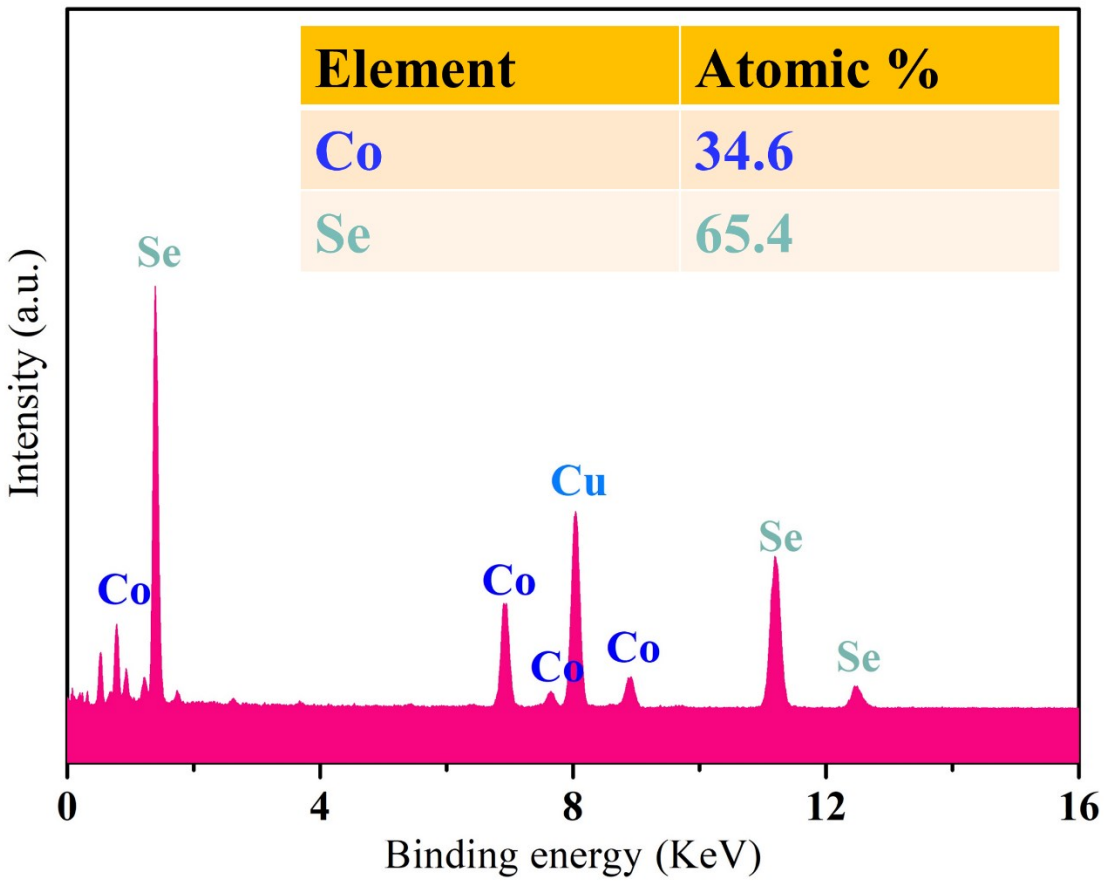


**Figure S3.** EDS spectrum of $CoSe_2$@N-CC.

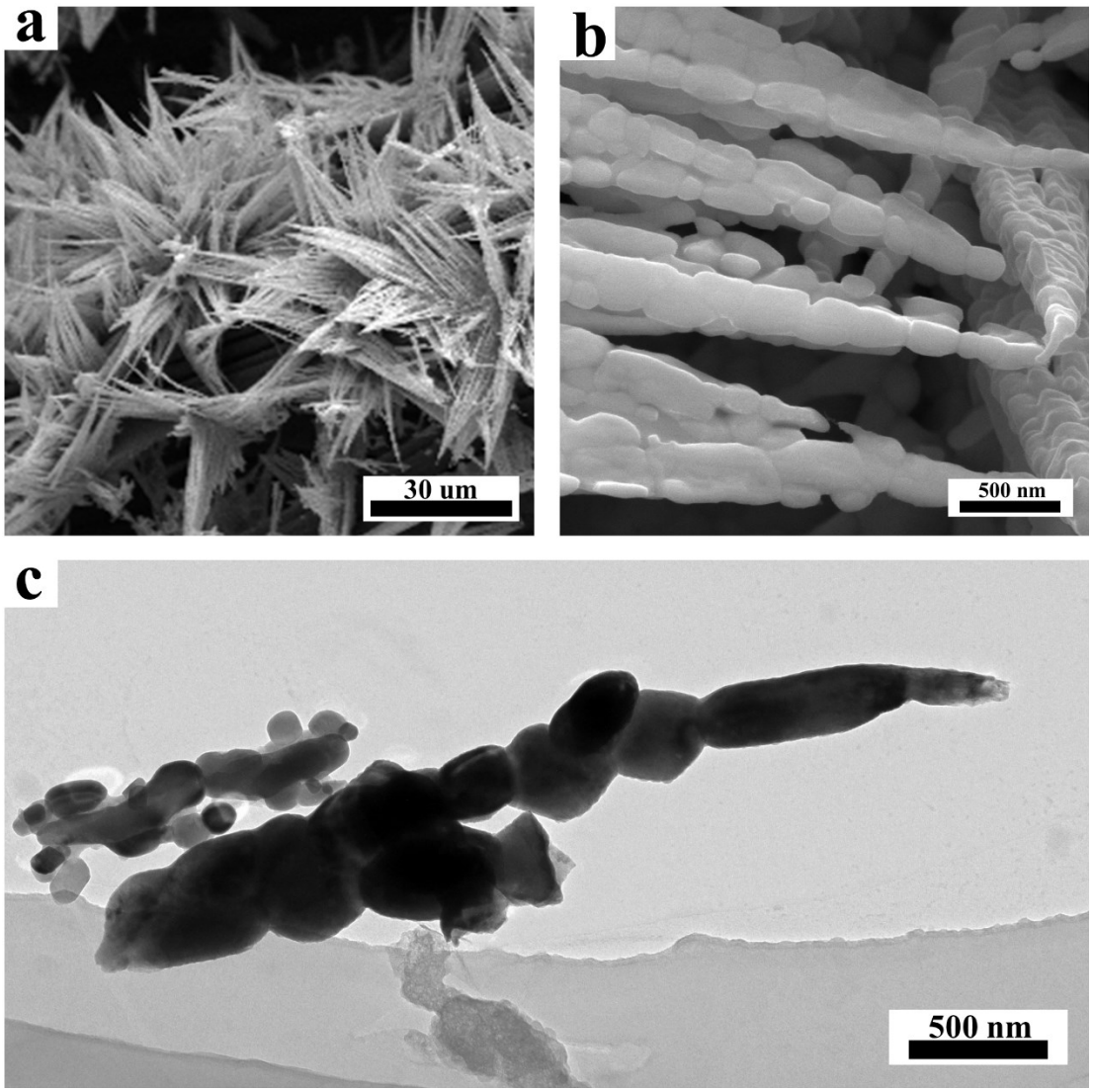


**Figure S4.** FESEM images of $V_{Se}$-$CoSe_2$@N-CC integrated electrode with low (a) and (b) high magnification after 24 h of drastic sonication; (c) the typical corresponding TEM image.

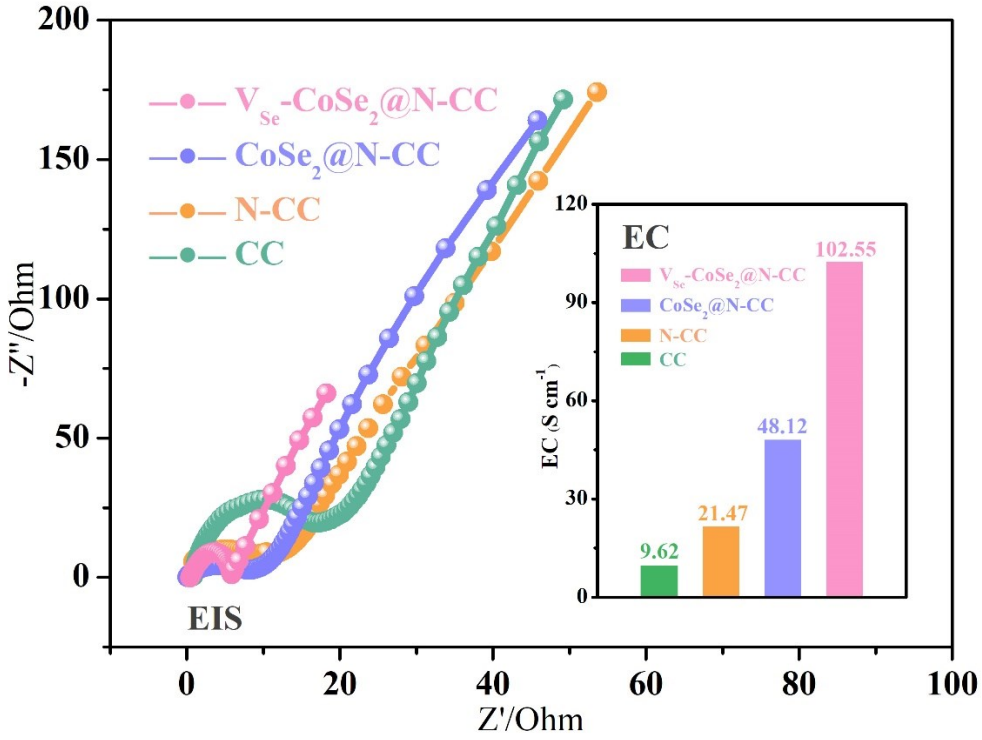


**Figure S5.** Electrochemical impedance spectroscopy (EIS) of $V_{Se}$-$CoSe_2$@N-CC, $CoSe_2$@N-CC N-CC, and CC; the illustration is the corresponding electronic conductivity.

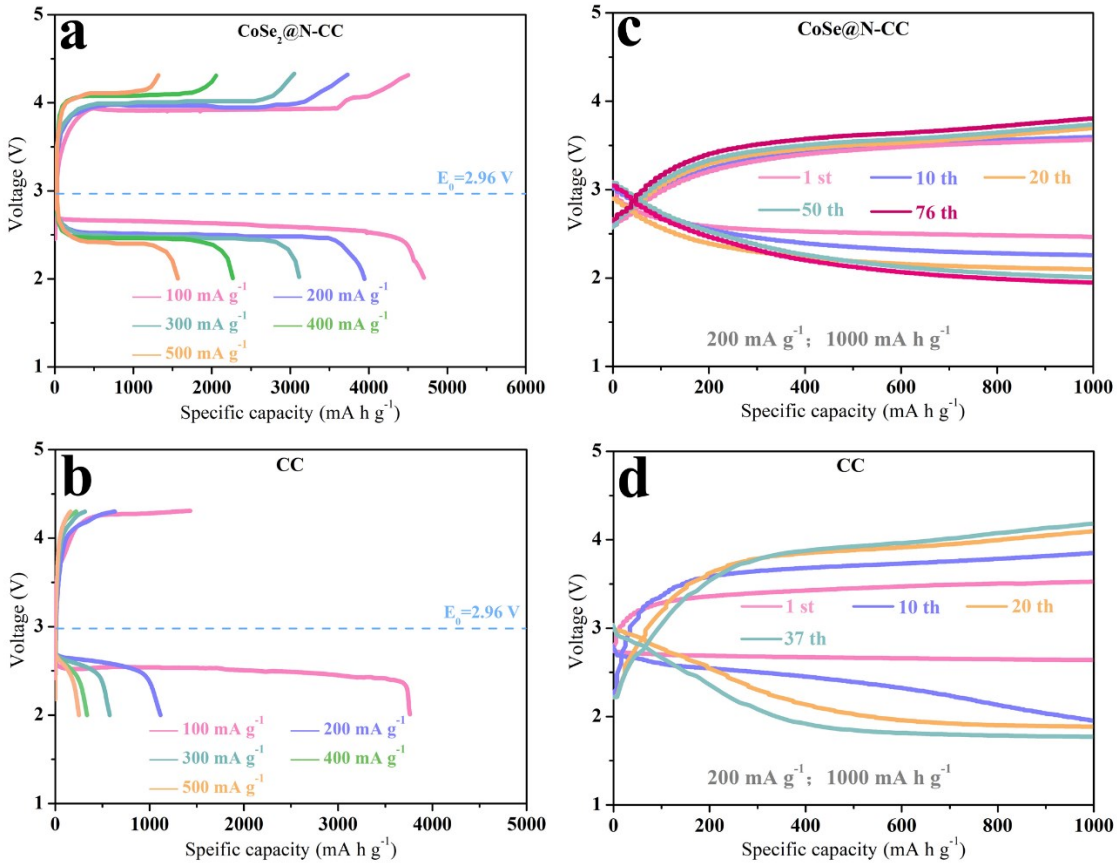


**Figure S6.**The rate performance of Li-$O_2$ cells based on (a) $CoSe_2$@N-CC, and (b) CC electrodes at various current density; the discharge/charge curves of Li-$O_2$ batteries with (c) $CoSe_2$@N-CC, and (d) CC electrodes at a current density of 200 mA $g^{-1}$ with a restricted capacity of 1000 mA h $g^{-1}$.

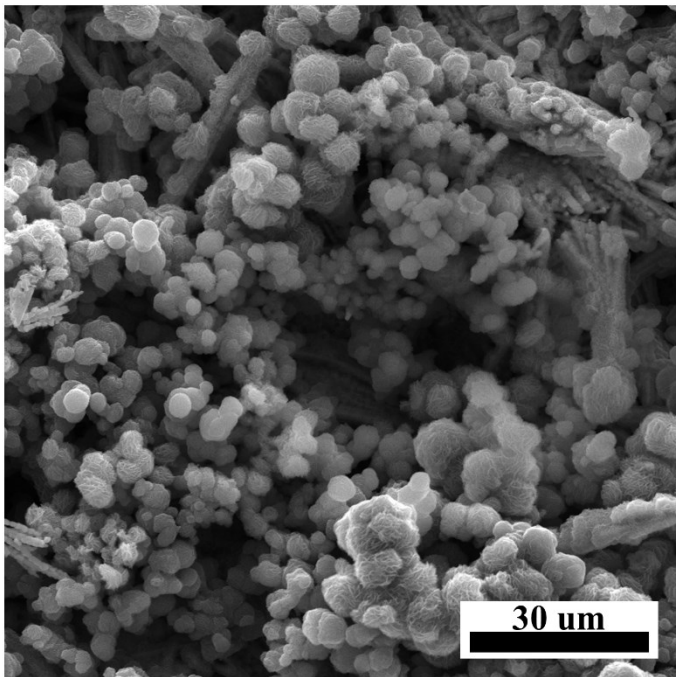


**Figure S7.** SEM image of $V_{Se}$-$CoSe_2$@N-CC electrode after fully discharge.

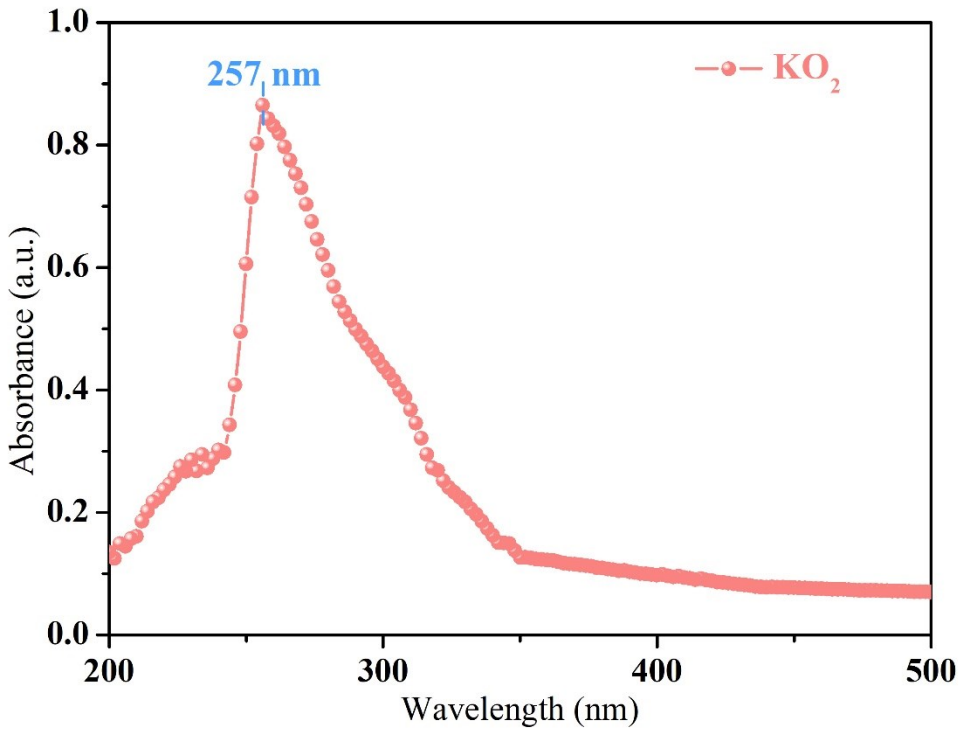


**Figure S8.** Ultraviolet-visible spectrum of $KO_2$ dissolved in TEGDME solution.

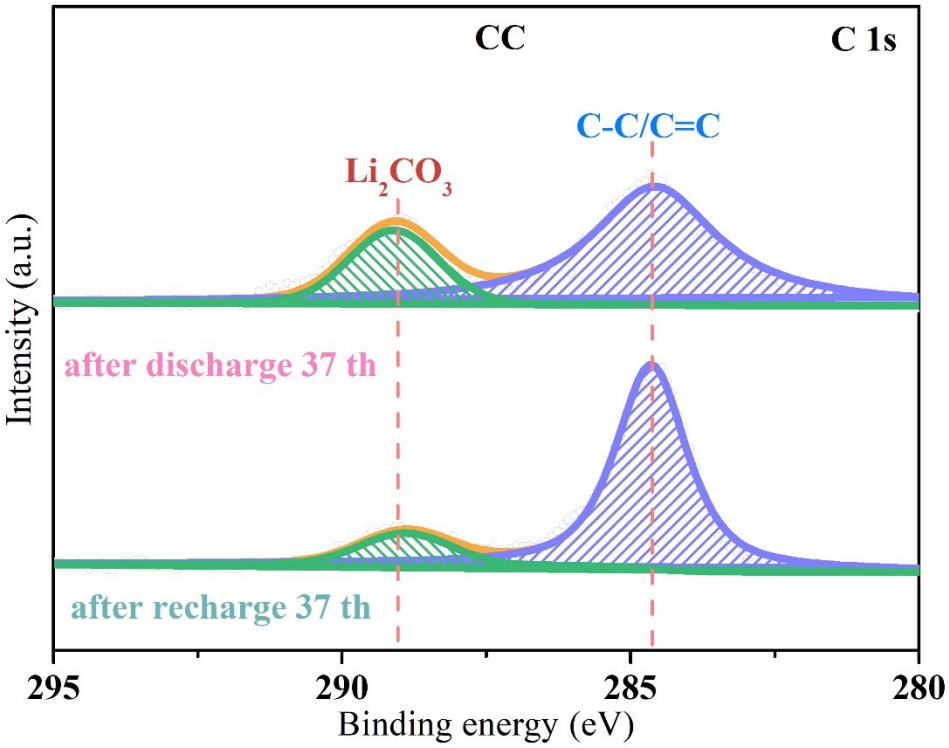


**Figure S9.** Typical XPS high-resolution spectrum of C 1s with the CC electrode after first (a) and 37 th (b) discharge/charge.

**Table S1.** The electrochemical performance comparison of $V_{Se}$-$CoSe_2$@N-CC oxygen electrode with transition metal chalcogenides electrodes.

| Catalysts | Current density ($mA\ g^{-1}$) | Discharge capacity ($mA\ h\ g^{-1}$) | Cycle number (cycles) | Ref. |
|---|---|---|---|---|
| **$MoS_2$** | 100 | 1250 | 50 | [1] |
| **$Co_3S_4$** | 100 | 5917 | 25 | [2] |
| **$Ni_3S_2$** | 400 | 3264 | 116 | [3] |
| **$NiCo_2S_4$** | 150 | 14173 | 101 | [4] |
| **$CoSe_2$/CoO** | 100 | 1500 | 30 | [5] |
| **$V_{Se}$-$CoSe_2$@N-CC** | 100 | 6089 | More than 490 | This work |


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**Table S2.** The electrochemical performance of different types of oxygen electrode.

| Catalysts | Current density | Cycle Performance (Cycles) | First Discharge Capacity (mA h $g^{-1}$) | Ref. |
|---|---|---|---|---|
| **$Co_3O_4$/CNTs** | 100 mA $g^{-1}$ | 116 | 4331 mA h $g^{-1}$ | [1] |
| **2D $Co_3S_4$ nanosheets** | 100 mA $g^{-1}$ | 25 | 5917 mA h $g^{-1}$ | [2] |
| **$CoS_2$/RGO** | 100 mA $g^{-1}$ | 20 | 3000 mA h $g^{-1}$ | [3] |
| **$MnCo_2O_4$ microspheres** | 200 mA $g^{-1}$ | 50 | 4861 mA h $g^{-1}$ | [4] |
| **NiO** | 100 mA $g^{-1}$ | 40 | 1260 mA h $g^{-1}$ | [5] |
| **$V_{Se}$-$CoSe_2$@N-CC** | 100 mA $g^{-1}$ | >490 | 6089 mA h $g^{-1}$ | This work |

Reference


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