Supporting Information

High Performance Organic Sodium-ion Hybrid Capacitor Based on Nano Structured Disodium Rhodizinate Rivaling Inorganic Hybrid Capacitors

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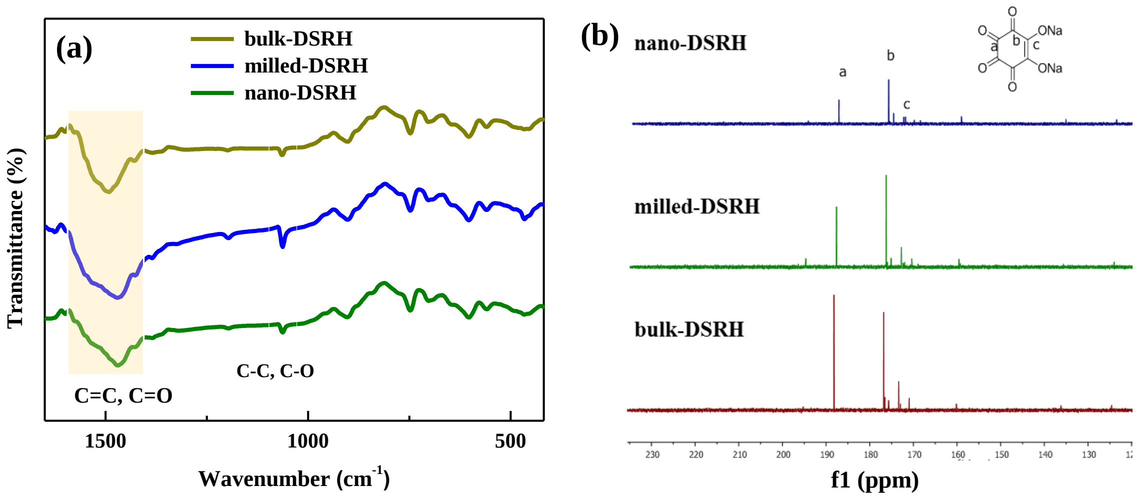


Fig. S1 (a) FT-IR spectrum, and (b) ^{13}C-NMR spectrum of various DSRH.

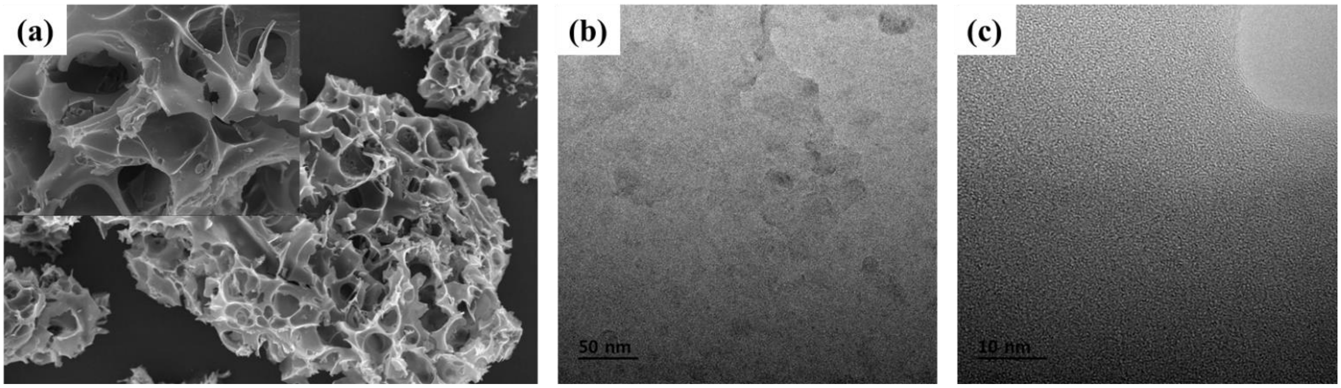


Fig. S2 (a) SEM image of CDC, (b) – (c) TEM images of CDC.

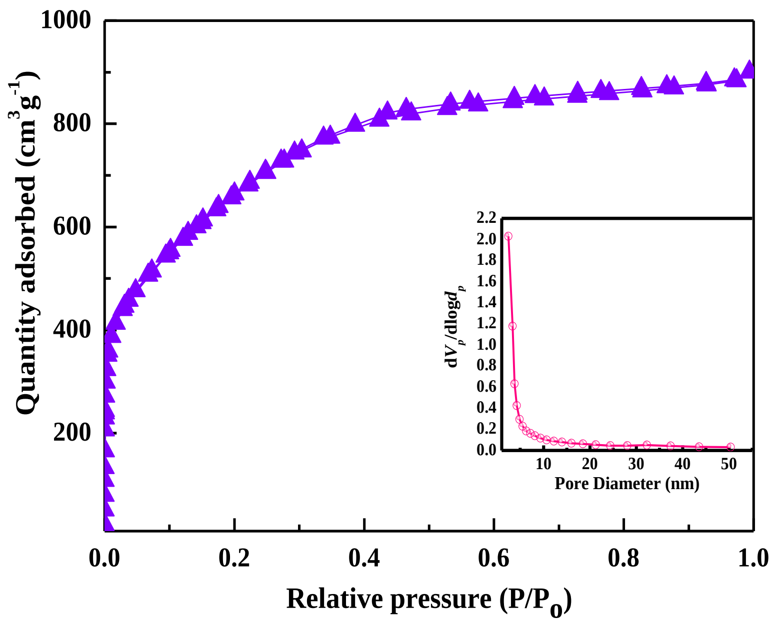


Fig. S3 N_2 adsorption/desorption isotherm of CDC, Inset: BJH pore size distribution

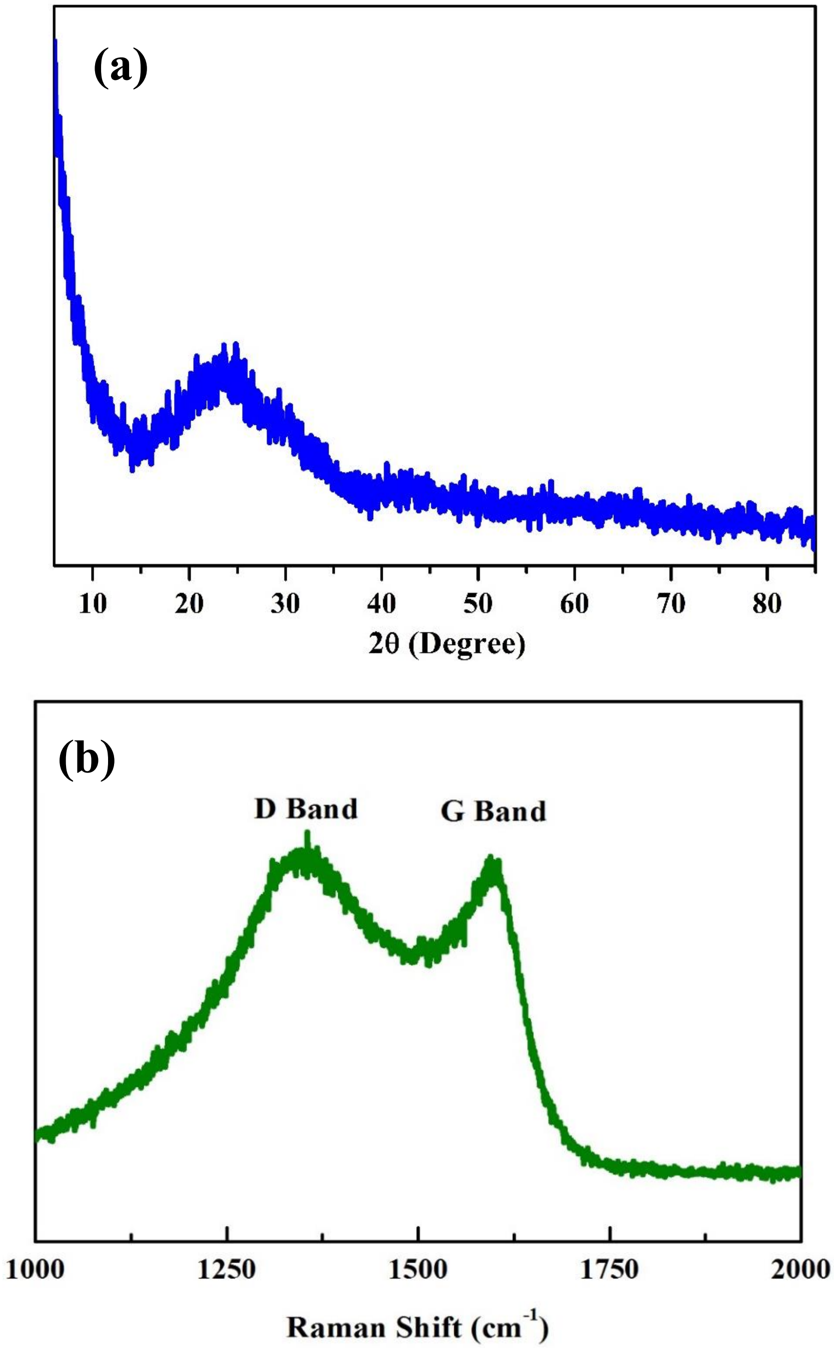


Fig. S4 (a) XRD pattern of CDC, and (b) Raman spectrum of CDC

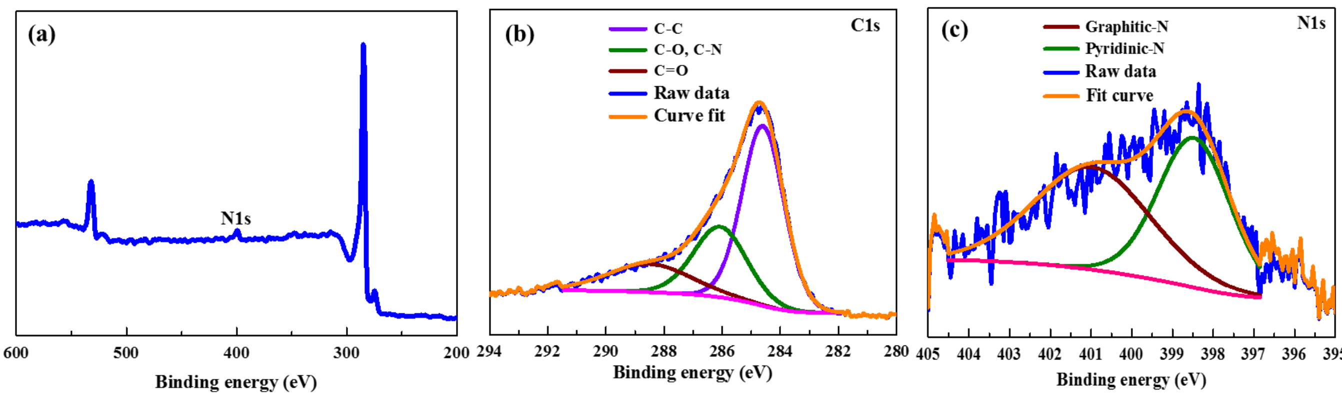


Fig. S5 (a) XPS survey spectrum of CDC, (b) deconvoluted C1s spectrum, and (c) deconvoluted N1s spectrum

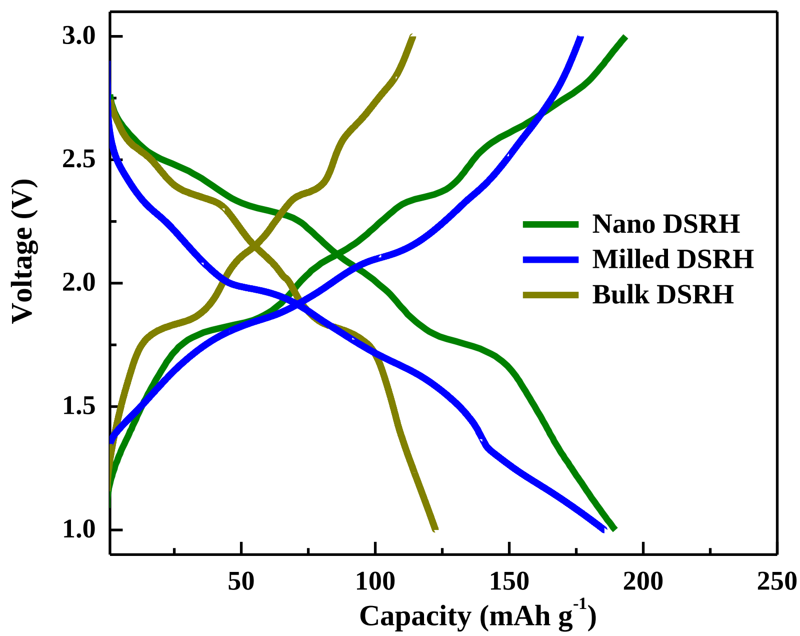


Fig. S6 CD curves of various DSRH at 0.1 A g^{-1}.

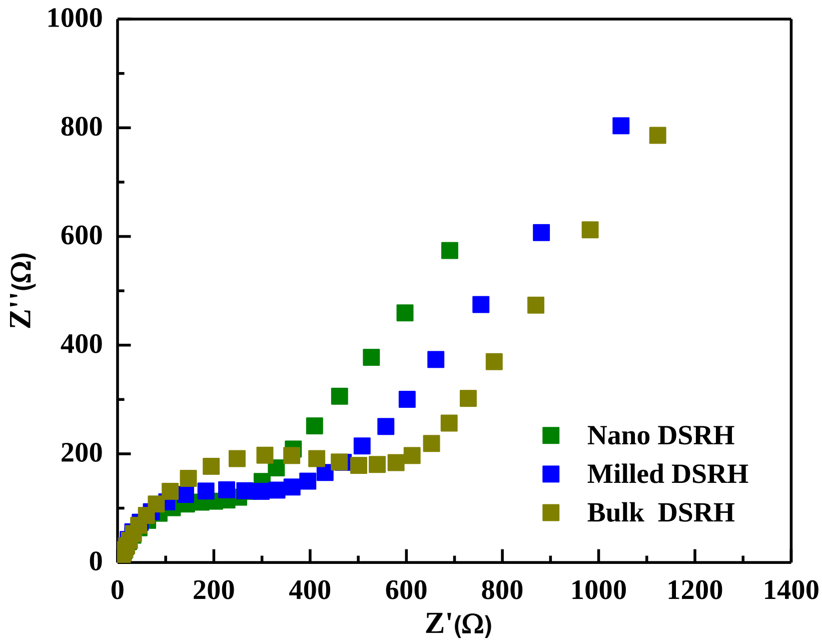


Fig. S7 Nyquist plots of various nanostructured DSRH.

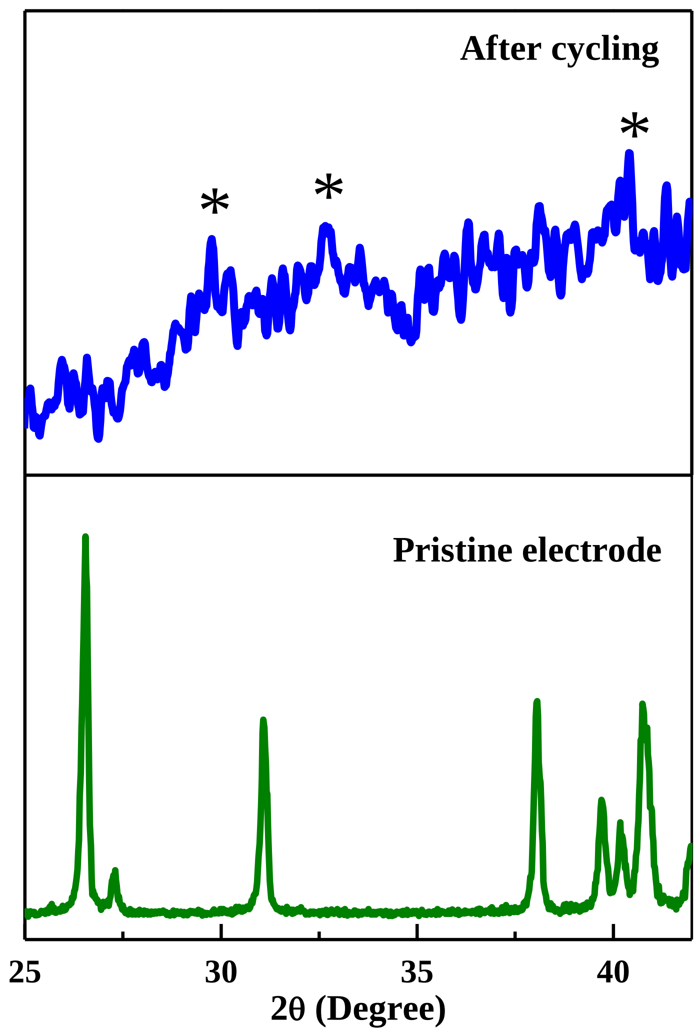
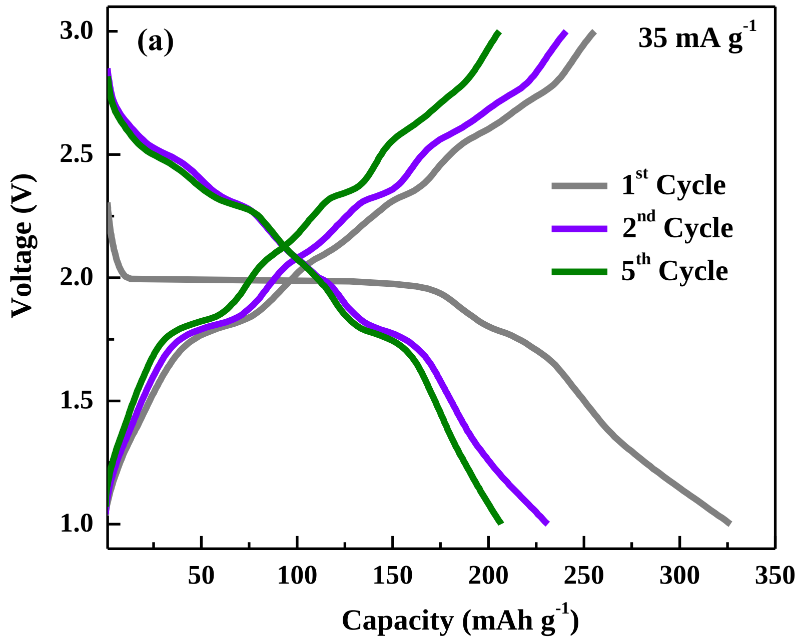


Fig. S8 XRD pattern of nano-DSRH before and after cycling.



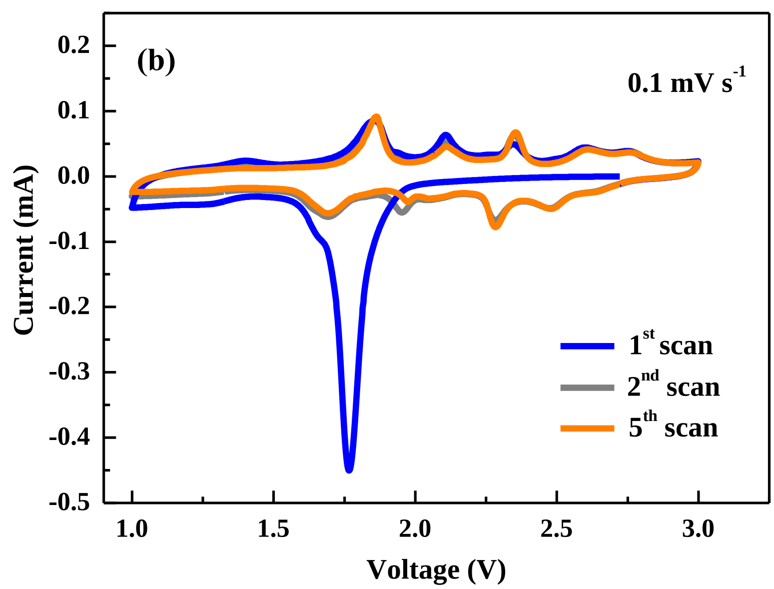


Fig. S9 (a) CD curves of nano-DSRH Vs. Na, and (b) CV curves of nano-DSRH Vs. Na

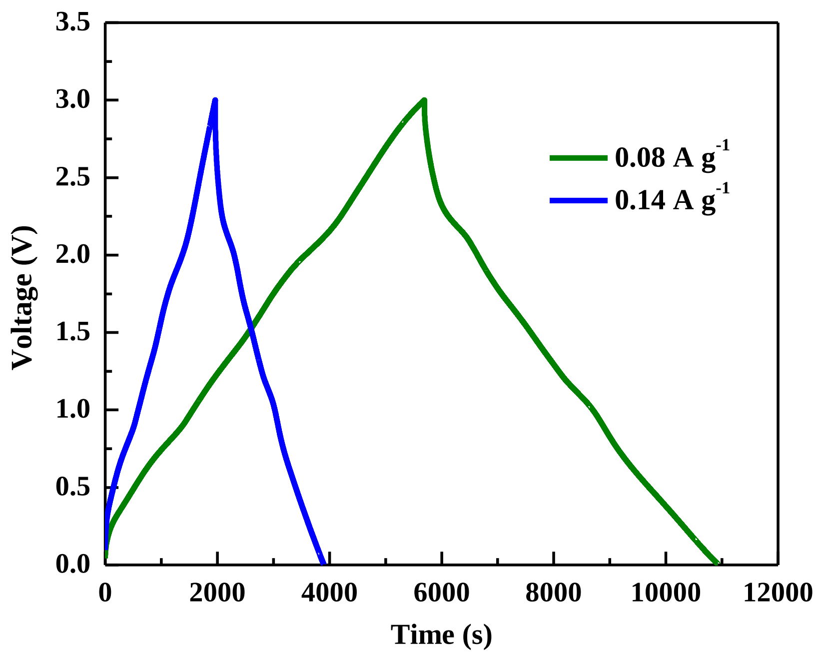


Fig. S10 CD curves of OHNC

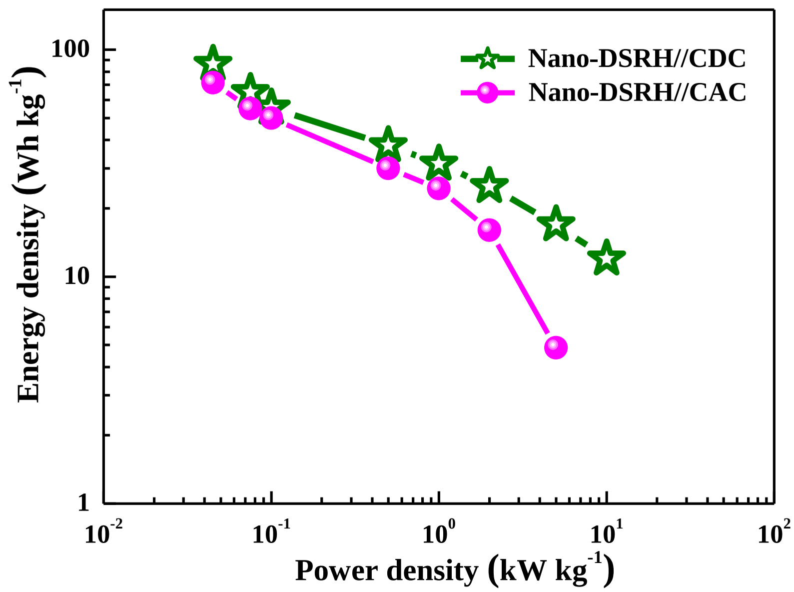


Fig. S11 Ragone plot comparing the performance OHNC with CDC and CAC cathode

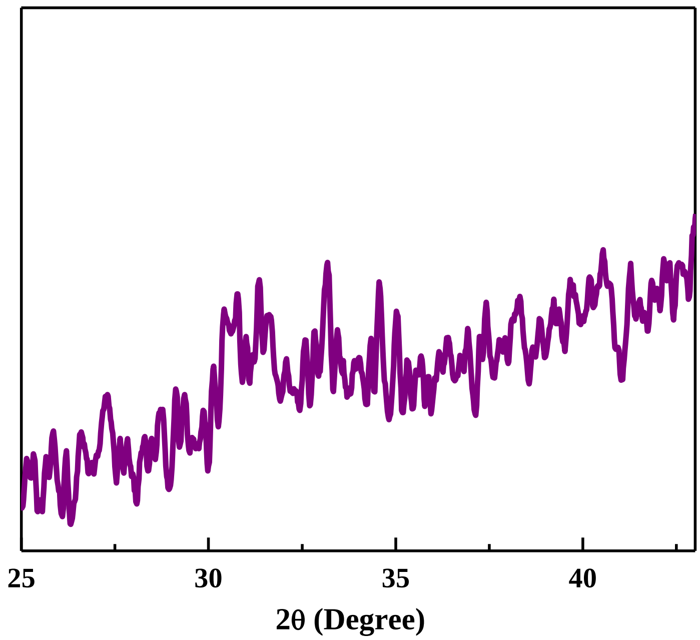


Fig. S12 XRD patterns of DSRH in ONHC after cycling.

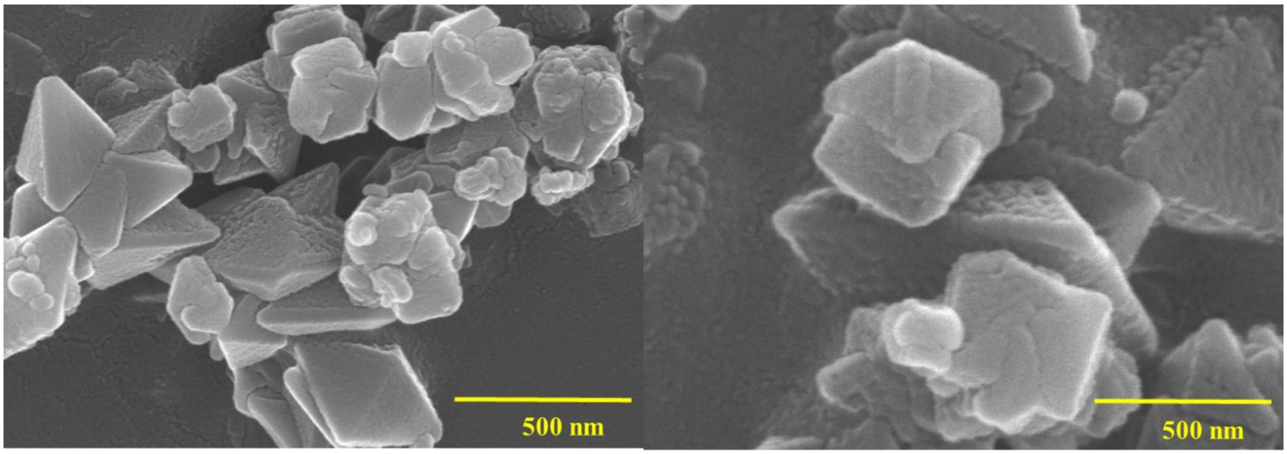


Fig. S13 SEM images of DSRH in ONHC after cycling.

System	*Energy Density (Wh kg^{-1})*	*Power Density (W kg^{-1})*	*Stability*
Organic sodium capacitor (This work)	**87**	**10000**	**85% after 10000 cycles**
V_2O_5-CNT/AC$_{[S1]}$	38	140	80% after 1000 cycles
rGO-TiO_2/AC$_{[S2]}$	8	9000	80% after 10000 cycles
rGO-Nb_2O_5/AC$_{[S3]}$	76	8000	78% - 3000 cycles
Na-TNT/AC$_{[S4]}$	34	889	98% after 1000 cycles
TiO_2-B/AC$_{[S5]}$	18	235	73% after 1200 cycles
Mesoporous TiO_2//AC$_{[S6]}$	64.2	1400	90% after 10000 cycles
$NaMn_{1/3}Ni_{1/3}Co_{1/3}PO_4$/AC$_{[S7]}$	15	400	95% after 1000 cycles
NVP/NVP$_{[S8]}$	26	290	65 % after 10000 cycles
$Li_4Ti_5O_{12}$/AC$_{[S9]}$	10	1000	84% after 9000 cycles
$Li_4Ti_5O_{12}$/Carbon clouds$_{[S10]}$	10	9000	82% after 10000 cycles
$LiCoO_2$//AC$_{[S11]}$	32	100	40% after 3000 cycles
Li_2MnSiO_4/AC$_{[S12]}$	37	1400	85% after 1000 cycles
$LiMn_{0.5}Ni_{0.5}O_4$/AC$_{[S13]}$	56	130	81% after 3000 cycles
$LiMn_2O_4$/AC$_{[S11]}$	38	100	98% after 3000 cycles
$LiCoPO_4$/AC$_{[S14]}$	11	1607	67% after 1000 cycles
$LiCo_{1/3}Ni_{1/3}Mn_{1/3}O_2$/AC$_{[S11]}$	42	100	90% after 500 Cycles
$LiTi_2(PO_4)_3$/AC$_{[S15]}$	14	180	48% after 1000 cycles
$Li_3V_2(PO_4)_3$/AC$_{[S16]}$	27	255	66% after 1000 cycles

Table S1 Comparison of performance of ONHC with various other systems.

References

S1. Z. Chen, V. Augustyn, X. Jia, Q. Xiao, B. Dunn and Y. Lu, *ACS Nano*, 2012, **6**, 4319-4327.

S2. H. Kim, M.-Y. Cho, M.-H. Kim, K.-Y. Park, H. Gwon, Y. Lee, K. C. Roh and K. Kang, *Adv. Energy Mater.*, 2013, **3**, 1500-1506.

S3. E. Lim, C. Jo, M. S. Kim, M.-H. Kim, J. Chun, H. Kim, J. Park, K. C. Roh, K. Kang, S. Yoon and J. Lee, *Adv. Funct. Mater.*, 2016, **26**, 3553.

S4. J. Yin, L. Qi and H. Wang, *ACS Appl. Mater. Interfaces*, 2012, **4**, 2762-2768.

S5. V. Aravindan, N. Shubha, W. C. Ling and S. Madhavi, *J. Mater. Chem. A*, 2013, **1**, 6145-6151.

S6. Z. Le, F. Liu, P. Nie, X. Li, X. Liu, Z. Bian, G. Chen, H. B. Wu and Y. Lu, *ACS Nano*, 2017, **11**, 2952-2960.

S7. R. Satish, V. Aravindan, W. C. Ling and S. Madhavi, *J. Power Sources*, 2015, **281**, 310-317.

S8. Z. Jian, V. Raju, Z. Li, Z. Xing, Y. S. Hu and X. Ji, *Adv. Funct. Mater.*, 2015, **25**, 5778-5785.

S9. V. Aravindan, W. Chuiling, M. V. Reddy, G. V. S. Rao, B. V. R. Chowdari and S. Madhavi, *Phys. Chem. Chem. Phys.*, 2012, **14**, 5808-5814.

S10. A. Banerjee, K. K. Upadhyay, D. Puthusseri, V. Aravindan, S. Madhavi and S. Ogale, *Nanoscale*, 2014, **6**, 4387-4394.

S11. Y. Wang, J. Luo, C. Wang, Y. Xia, *J. Electrochem. Soc*. **2006**, 153, A1425.

S12. K. Karthikeyan, V. Aravindan, S. B. Lee, I. C. Jang, H. H. Lim, G. J. Park, M. Yoshio and Y. S. Lee, *J. Power Sources*, 2010, **195**, 3761-3764.

S13. N. Arun, A. Jain, V. Aravindan, S. Jayaraman, W. Chui Ling, M. P. Srinivasan and S. Madhavi, *Nano Energy*, 2015, **12**, 69-75.

S14. K. Karthikeyan, S. Amaresh, K. J. Kim, S. H. Kim, K. Y. Chung, B. W. Cho and Y. S. Lee, *Nanoscale*, 2013, **5**, 5958-5964.

S15. V. Aravindan, W. Chuiling, M. V. Reddy, G. V. S. Rao, B. V. R. Chowdari and S. Madhavi, *Phys. Chem. Chem. Phys.*, 2012, **14**, 5808-5814.

S16. R. Satish, V. Aravindan, W. C. Ling and S. Madhavi, *J. Power Sources*, 2015, **281**, 310-317.