Electronic Supplementary Information

Molecularly-Designed, Dual-Doped Mesoporous Carbon/SWCNT Nanoshields for Lithium Battery Electrode Materials

Ye-Ri Jang,[†a] Ju-Myung Kim,[†a] Jung-Han Lee,[a] Sung-Ju Cho,[a] Guntae Kim,[a] Young-Wan Ju,[a] Sun-Hwa Yeon,*[b] JongTae Yoo,*[a] and Sang-Young Lee*[a]

[a]Department of Energy Engineering, School of Energy and Chemical Engineering, Ulsan National Institute of Science and Technology (UNIST), Ulsan 44919, Korea

[b]Energy Storage Laboratory, Korea Institute of Energy Research (KIER), Daejeon 34129, Korea

†These authors contributed equally.

*Correspondence and requests for materials should be addressed to S.-H. Yeon (email: ys93@kier.re.kr), J. Yoo (email: jongtaeyoo@unist.ac.kr), and S.-Y. Lee (email: syleek@unist.ac.kr)

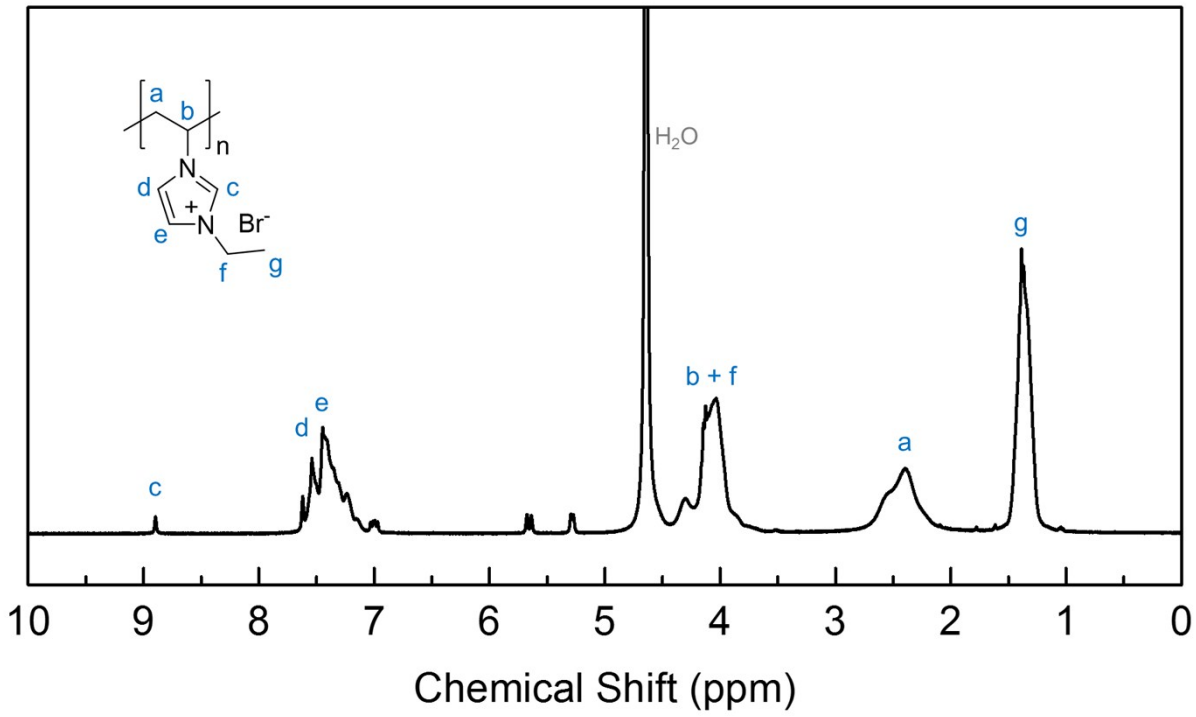

Figure S1. ^{1}H-NMR spectrum of PVIm[Br].

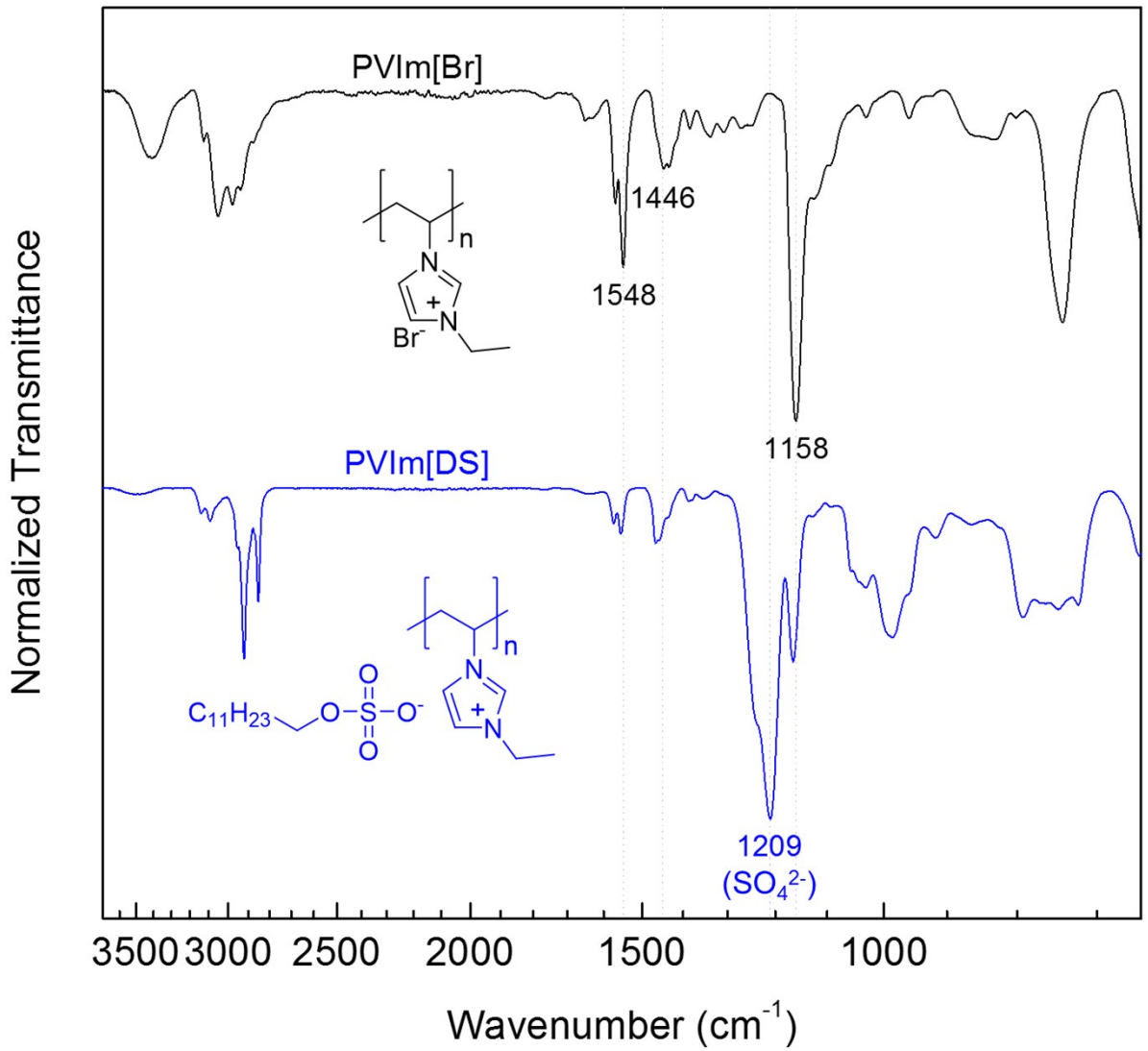

Figure S2. FT-IR spectra of PVIm[Br] and PVIm[DS], along with their chemical structures.

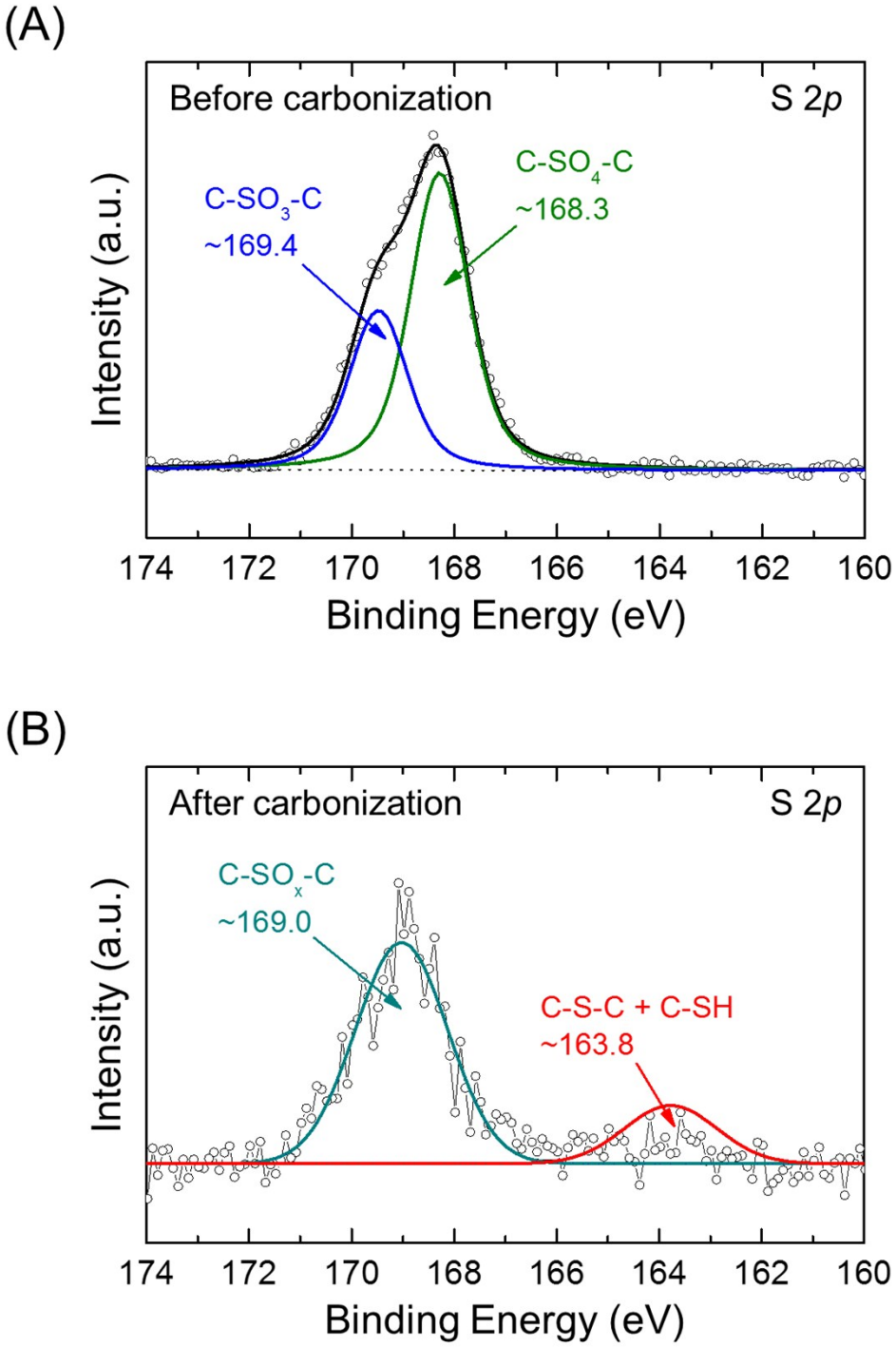

Figure S3. XPS S 2*p* spectra of PVIm[DS]: (A) Before carbonization. (B) After carbonization (at 600 °C for 2 h in Ar atmosphere).

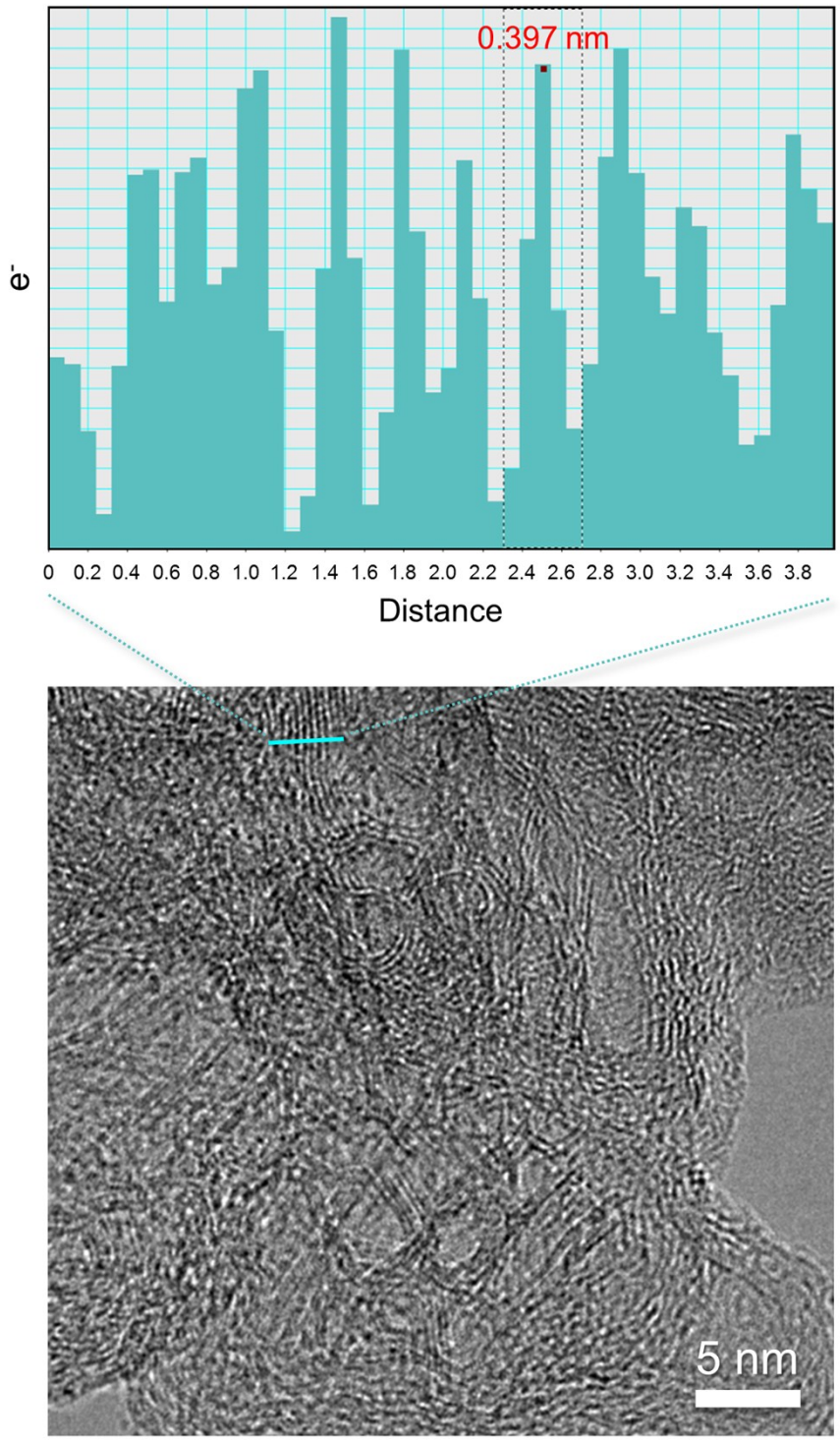

Figure S4. (Bottom) HRTEM image of PVIm[DS]-derived model carbon film and (Top) its intensity profile.

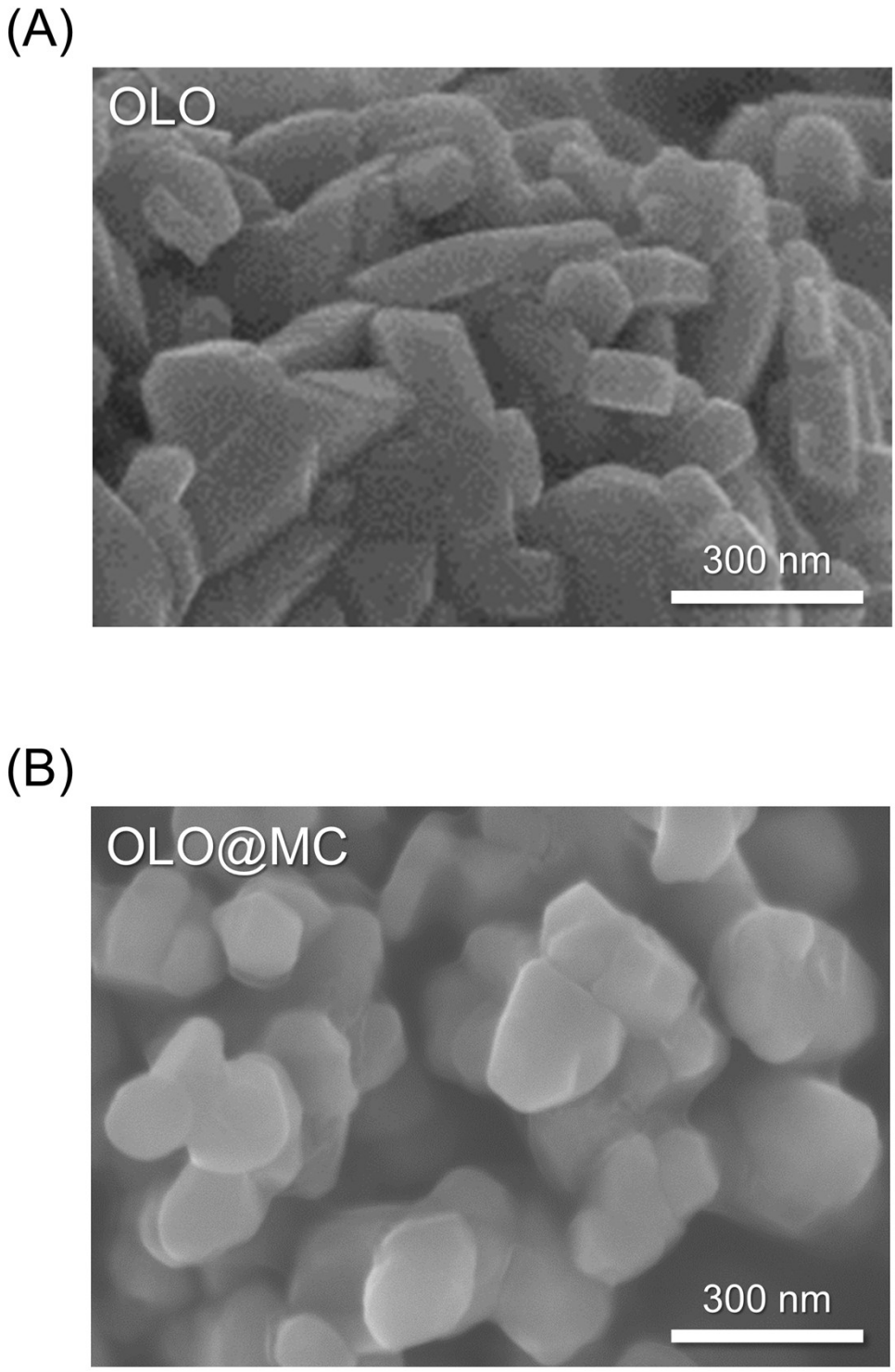

Figure S5. SEM images of (A) pristine OLO and (B) OLO@MC particles.

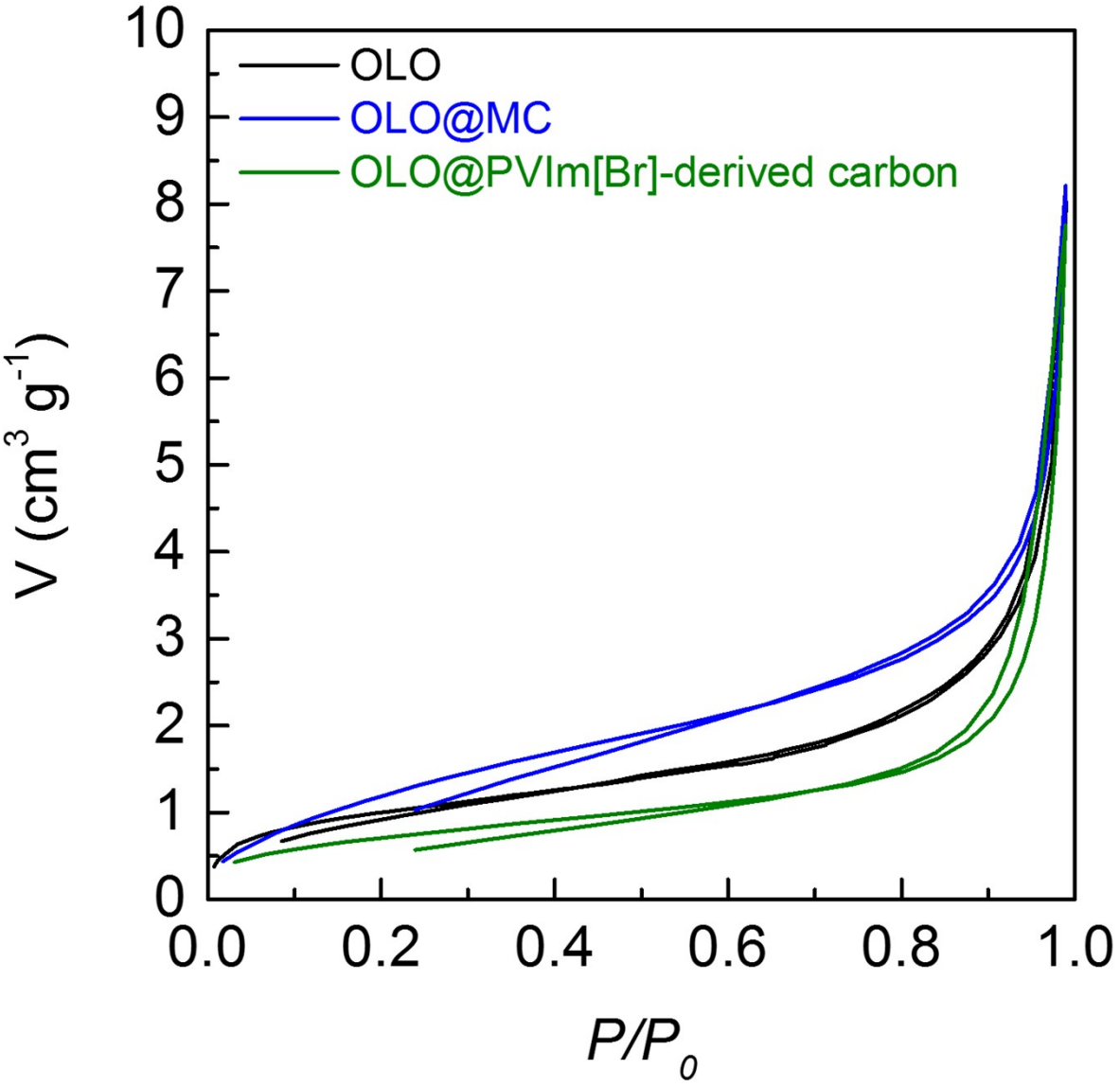

Figure S6. N_2 adsorption-desorption isotherms of pristine OLO, OLO@MC, and OLO@PVIm[Br]-derived carbon.

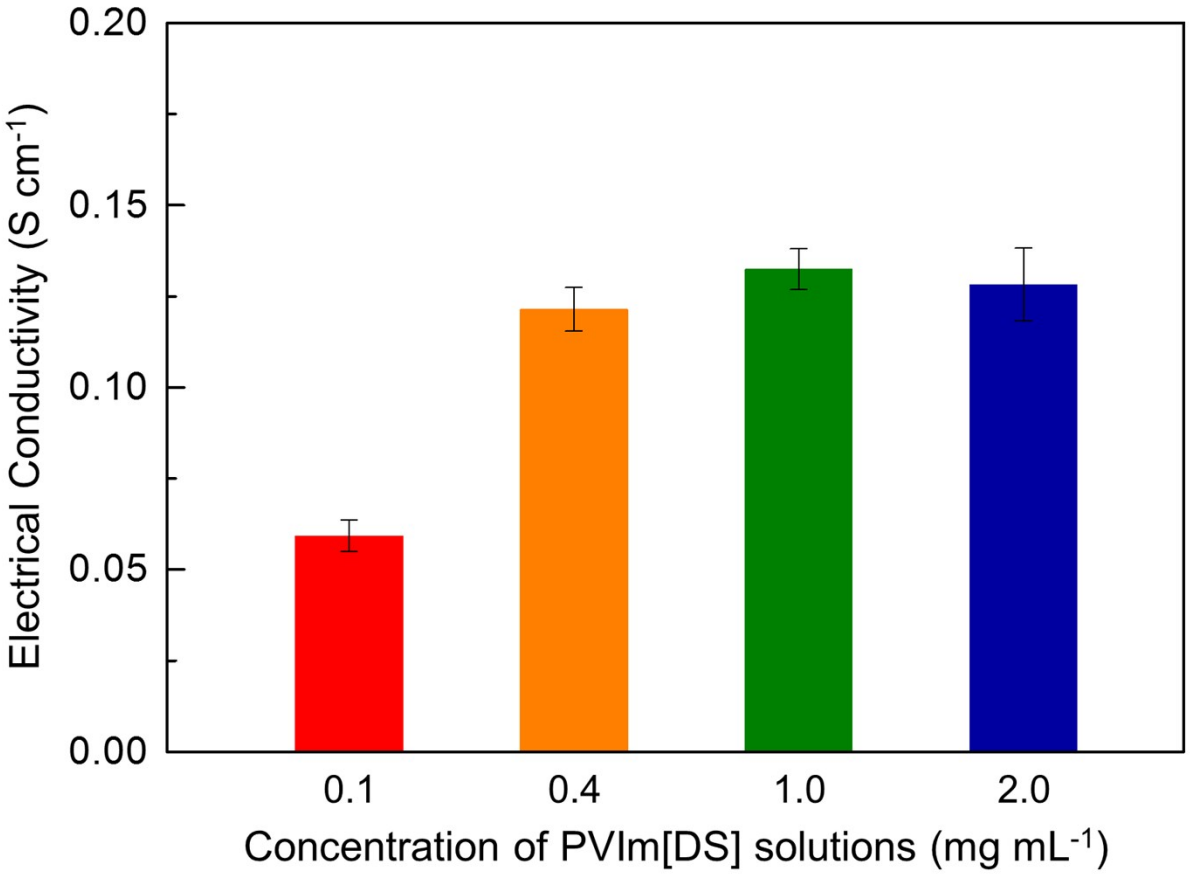

Figure S7. Electrical conductivity of OLO@MC cathodes as a function of initial concentration (varying from 0.1 to 2.0 mg mL^{-1}) of PVIm[DS] coating solution.

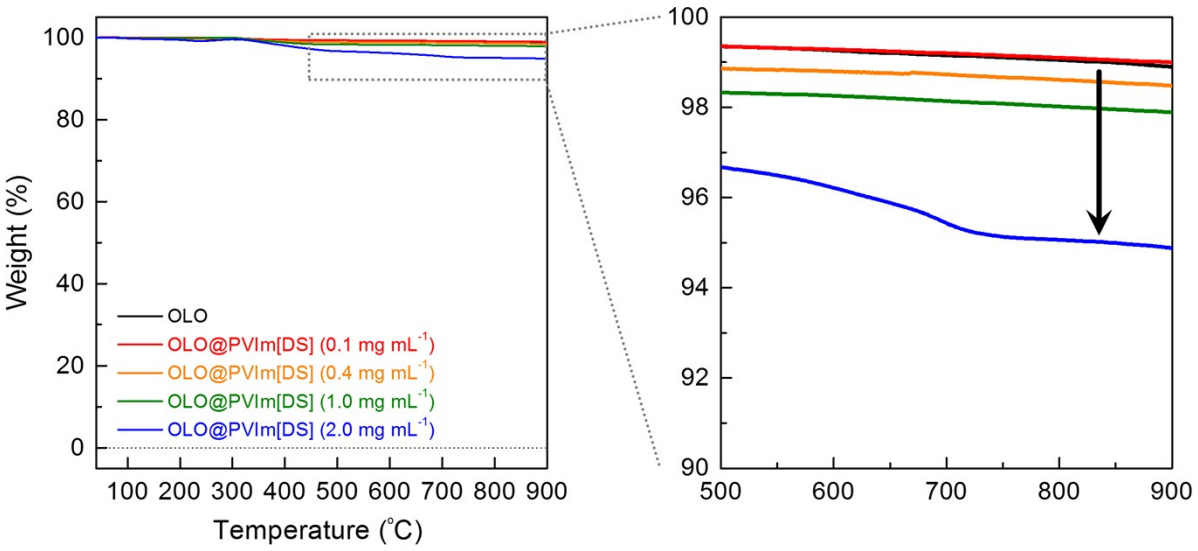

Figure S8. TGA profiles of OLO@MC as a function of initial concentration (varying from 0.1 to 2.0 mg mL^{-1}) of PVIm[DS] coating solution.

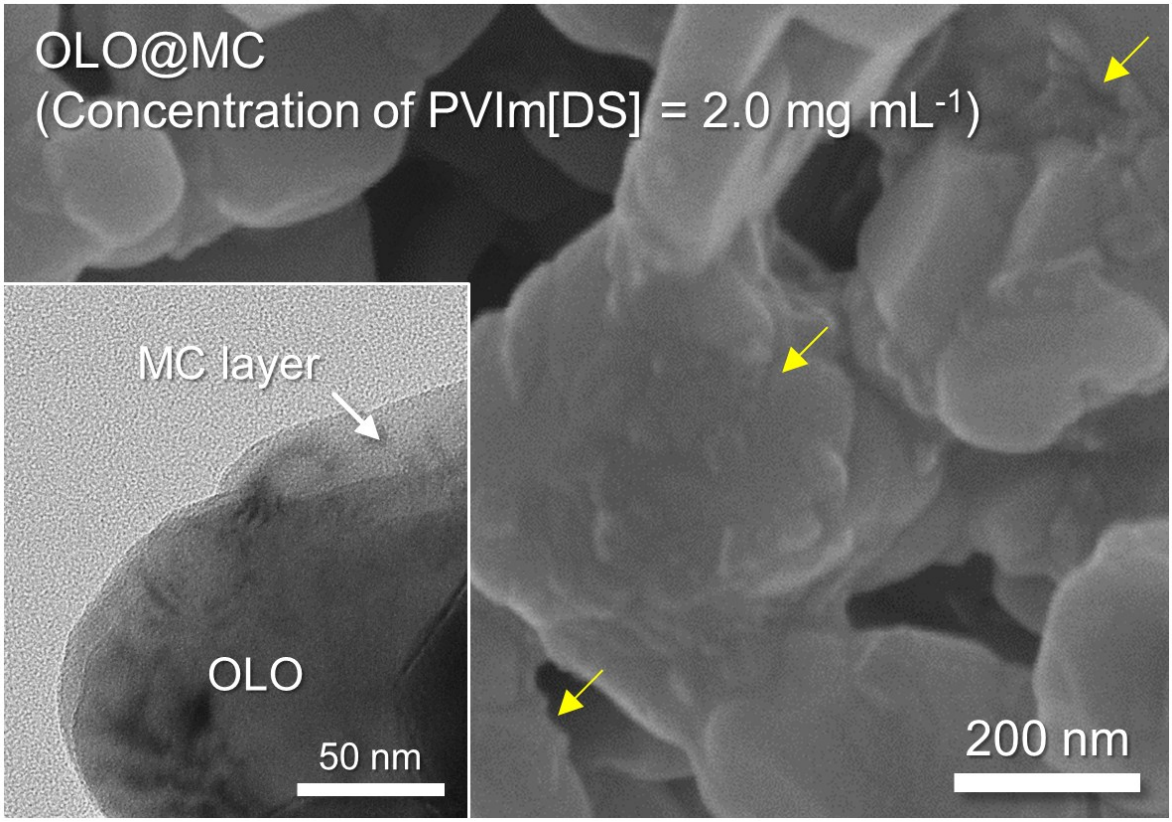

Figure S9. SEM and HRTEM (inset) images of OLO@MC prepared from PVIm[DS] coating solution with initial concentration of 2.0 mg mL^{-1}. Yellow arrows indicate the thick and irregularly-deposited MC shell on the OLO surface.

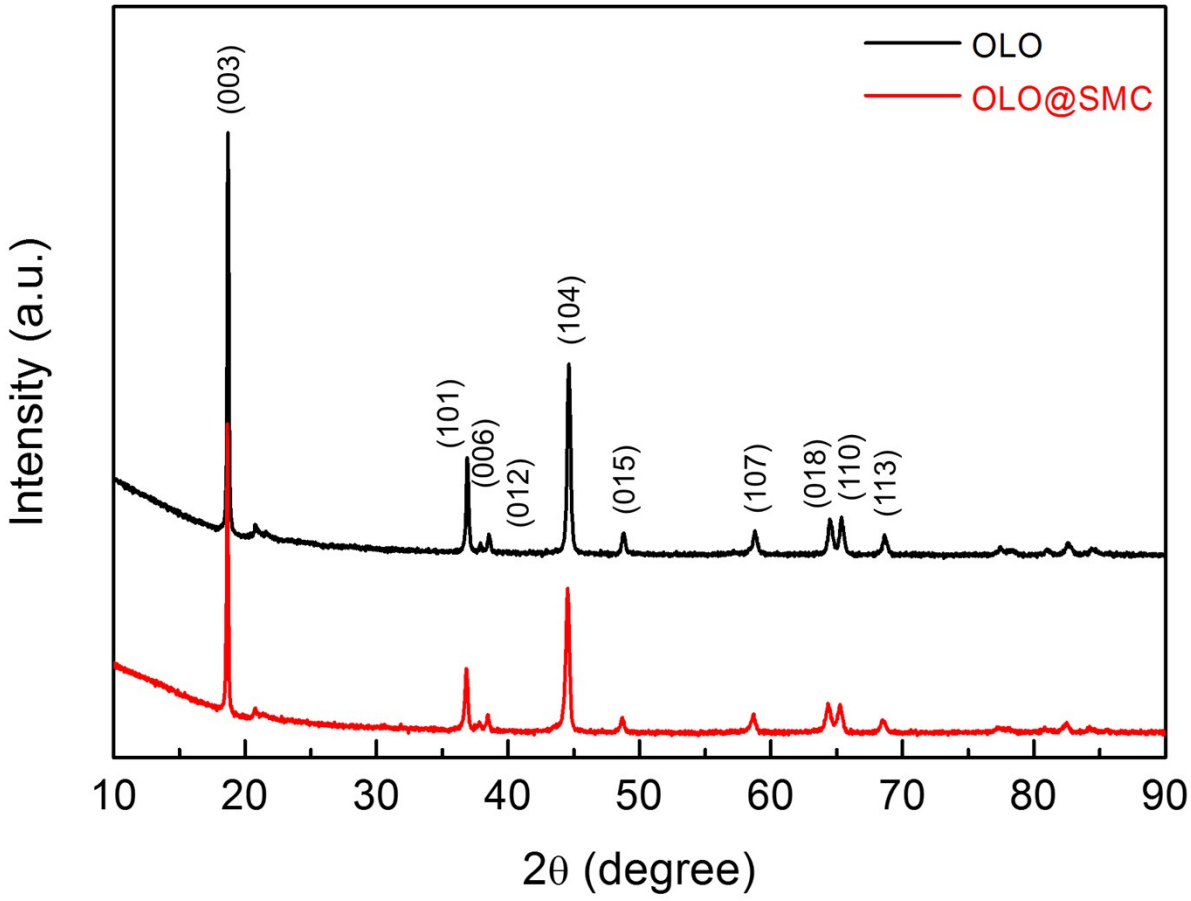

Figure S10. XRD patterns of pristine OLO and OLO@SMC particles.

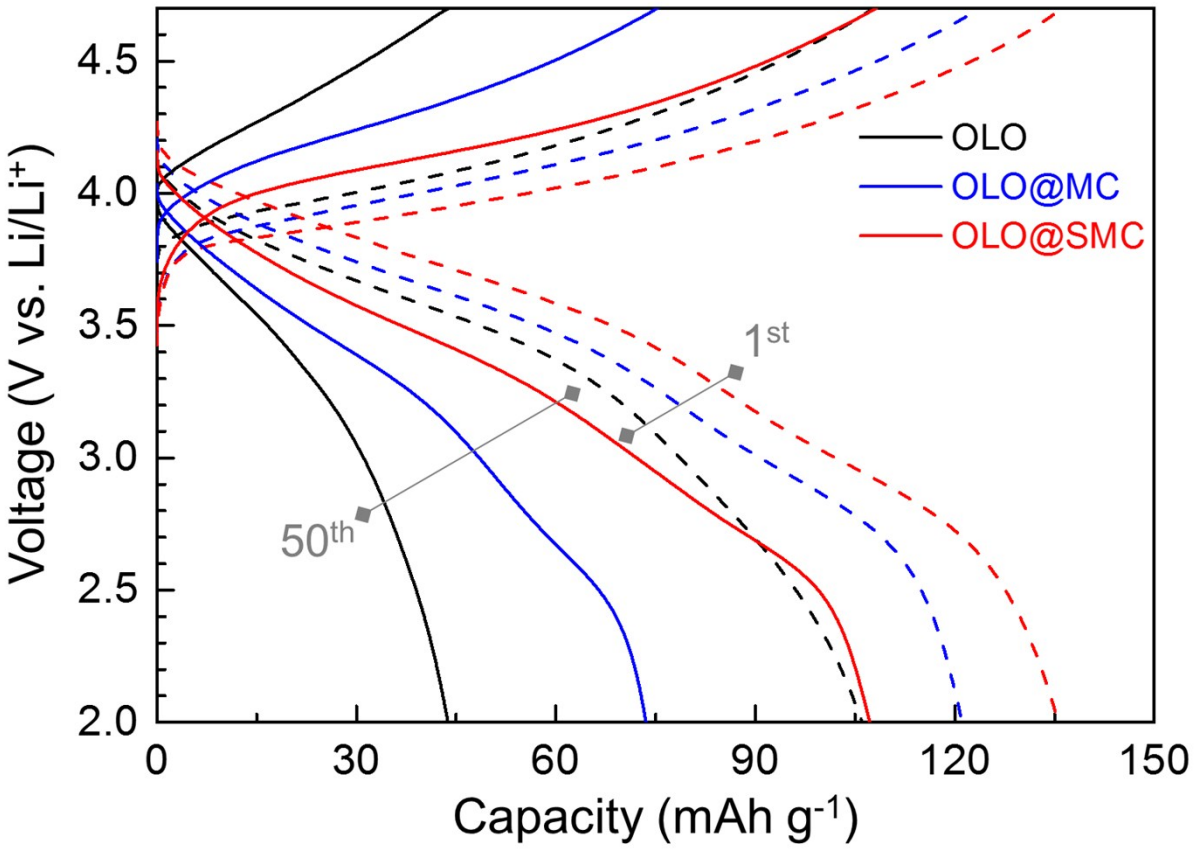

Figure S11. Charge/discharge profiles (for 1st and 50th cycles) of pristine OLO, OLO@MC, and OLO@SMC cathodes, wherein the cells were cycled at charge/discharge current density of 3.0 C/3.0 C under voltage range of 2.0–4.7 V.

Table S1. Comparison of composite ratio and areal mass loading used in this study with previously reported results.

Publication /Chemical structure of OLO	Composite ratio (%)			Mass Loading (mg cm^{-2})
	Active material	Conductive agent	Binder	
This work /0.49Li_2MnO_3·0.51$LiNi_{0.37}Co_{0.24}Mn_{0.39}O_2$	**92**	**4**	**4**	**~14**
Adv. Mater. **2015**, *27*, 3915. /$Li[Li_{0.2}Mn_{0.568}Ni_{0.2}X_{0.032}]O_2$ (X = Si, Sn, and Mn)	80	10	10	2 - 3
Adv. Energy Mater. **2015**, *5*, 1500274. /$Li_{1.17}Ni_{0.17}Co_{0.17}Mn_{0.5}O_2$(0.4$Li_2MnO_3$·0.6$LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$)	80	10	10	4.5
Adv. Energy Mater. **2013**, *3*, 1299. /$Li_{1.2}Ni_{0.13}Mn_{0.54}Co_{0.13}O_2$	80	10	10	2.9
Nano Lett. **2014**, *14*, 5965. /hydrazine treated 0.5Li_2MnO_3-0.5$LiNi_{0.5}Mn_{0.5}O_2$	90	5	5	6.2
J. Mater. Chem. A **2015**, *3*, 17113. /$Li[Li_{0.2}Co_{0.13}Ni_{0.13}Mn_{0.54}]O_2$	80	10	10	2
J. Mater. Chem. A **2015**, *3*, 13933. /0.5Li_2MnO_3·0.5$LiNi_{0.5}Co_{0.2}Mn_{0.3}O_2$	85	10	5	3
J. Mater. Chem. A **2015**, *3*, 17627. /$Li(Li_{0.17}Ni_{0.25}Mn_{0.58})O_2$	75	15	10	4.97
ACS Appl. Mater. Interfaces **2015**, *7*, 8319. /$Li_{1.17}Ni_{0.17}Mn_{0.5}Co_{0.17}O_2$	80	10	10	4.97
ACS Appl. Mater. Interfaces **2014**, *6*, 21711. /$Li[Li_{0.2}Fe_{0.1}Ni_{0.15}Mn_{0.55}]O_2$	80	10	10	3