

Wide-Temperature Electrolytes for Lithium-Ion Batteries

Qiuyan Li,[†] Shuhong Jiao,[†] Langli Luo,[‡] Michael S. Ding,[§] Jianming Zheng,[†] Samuel S. Cartmell,[†] Chong-Min Wang,[‡] Kang Xu,[§] Ji-Guang Zhang,[†] Wu Xu*,[†]

[†] *Energy and Environmental Directorate, Pacific Northwest National Laboratory, 902 Battelle Boulevard, Richland, Washington 99354, United States*

[‡] *Environmental and Molecular Sciences Laboratory, Pacific Northwest National Laboratory, 3335 Innovation Boulevard, Richland, Washington 99354, United States*

[§] *Sensors and Electron Devices Directorate, U.S. Army Research Laboratory, 2800 Powder Mill Road, Adelphi, Maryland 20783, United States*

* Corresponding Author. E-mail: wu.xu@pnnl.gov

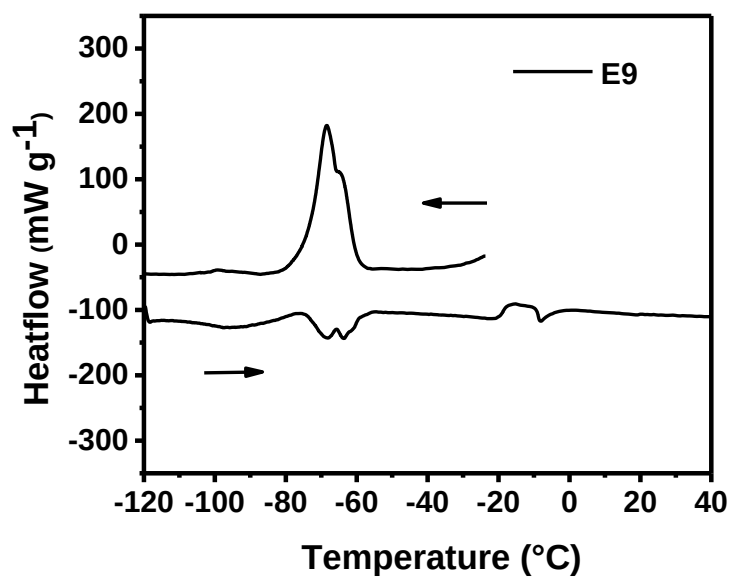


Figure S1. DSC curve of the control electrolyte E9, 1.0 M LiPF₆ in EC-EMC (3:7 by vol.).

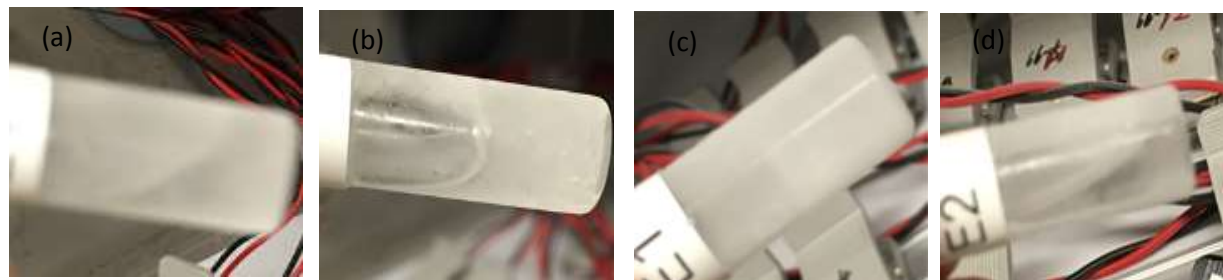


Figure S2. Pictures of the states of electrolytes E1 and E2 at different temperatures. (a) E1 at -20°C; (b) E1 at -30°C; (c) E1 at -40°C; (d) E2 at -40°C.

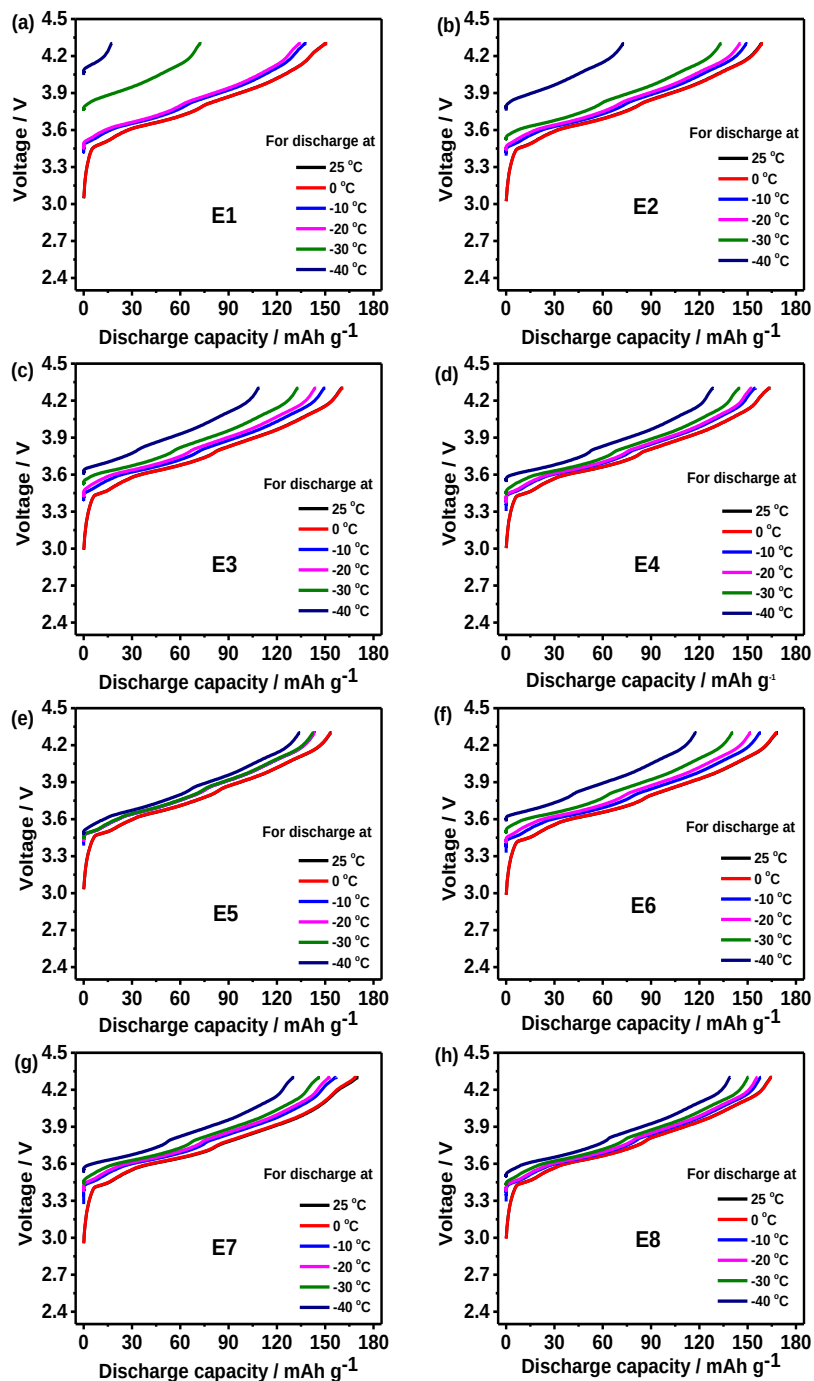


Figure S3. Charge voltage profiles of graphite||NCA coin cells at room temperature for discharging at different temperatures with (a) E1, (b) E2, (c) E3, (d) E4, (e) E5, (f) E6, (g) E7, and (h) E8, respectively. Since the charge process at room temperature occurred right after the previous discharge at various temperatures, the capacity of the charging at room temperature would be almost equal to the capacity of the previous discharging process. However, all cells were fully charged at room temperature for each specified temperature discharging so it doesn't affect the discharge capacity at different temperatures.

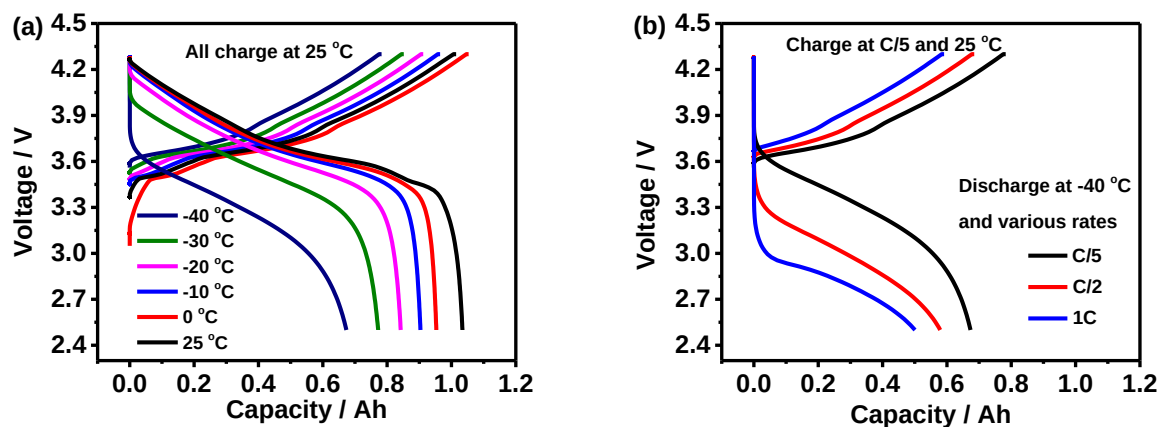


Figure S4. Charge and discharge profiles of 1 Ah graphite||NMC pouch cells with E8 electrolyte. (a) Charge voltage profiles at room temperature and discharge capacity at different temperatures at C/5 rate, and (b) charge voltage profiles at room temperature and at C/5 rate and discharge capacity at -40°C at three different discharge rates.