A Systematic Study of Some Promising Electrolyte Additives in $Li[Ni_{1/3}Mn_{1/3}Co_{1/3}]O_2$/Graphite, $Li[Ni_{0.5}Mn_{0.3}Co_{0.2}]$/Graphite and $Li[Ni_{0.6}Mn_{0.2}Co_{0.2}]$/Graphite Pouch Cells

Lin Ma[a], Julian Self[a], Mengyun Nie[a] and J. R. Dahn[a]
[a]*Department of Physics and Atmospheric Science, Dalhousie University, Halifax, B3H 3J5, Canada*

e-mail address of the presenting author: l.ma@dal.ca

$Li[Ni_{1/3}Mn_{1/3}Co_{1/3}]O_2$ (NMC111)/graphite, $Li[Ni_{0.5}Mn_{0.3}Co_{0.2}]O_2$ (NMC532)/graphite and $Li[Ni_{0.6}Mn_{0.2}Co_{0.2}O_2]$ (NMC622)/graphite pouch cells were examined with and without electrolyte additives using the ultra high precision charger (UHPC) at Dalhousie University, electrochemical impedance spectroscopy (EIS), gas evolution measurements and "cycle-store" tests. The electrolyte additives tested were vinylene carbonate (VC), prop-1-ene-1,3-sultone (PES), pyridine-boron trifluoride (PBF), 2% PES + 1% methylene methanedisulfonate (MMDS) + 1% tris(trimethylsilyl) phosphite (TTSPi) (PES211) and 0.5% pyrazine di-boron trifluoride (PRZ) + 1% MMDS. The charge end-point capacity slippage, capacity fade, columbic efficiency (CE), impedance change during cycling, gas evolution and voltage drop during "cycle-store" testing were compared to gain an understanding of the effects of these promising electrolyte additives or additive combinations on different NMC/graphite pouch cells.

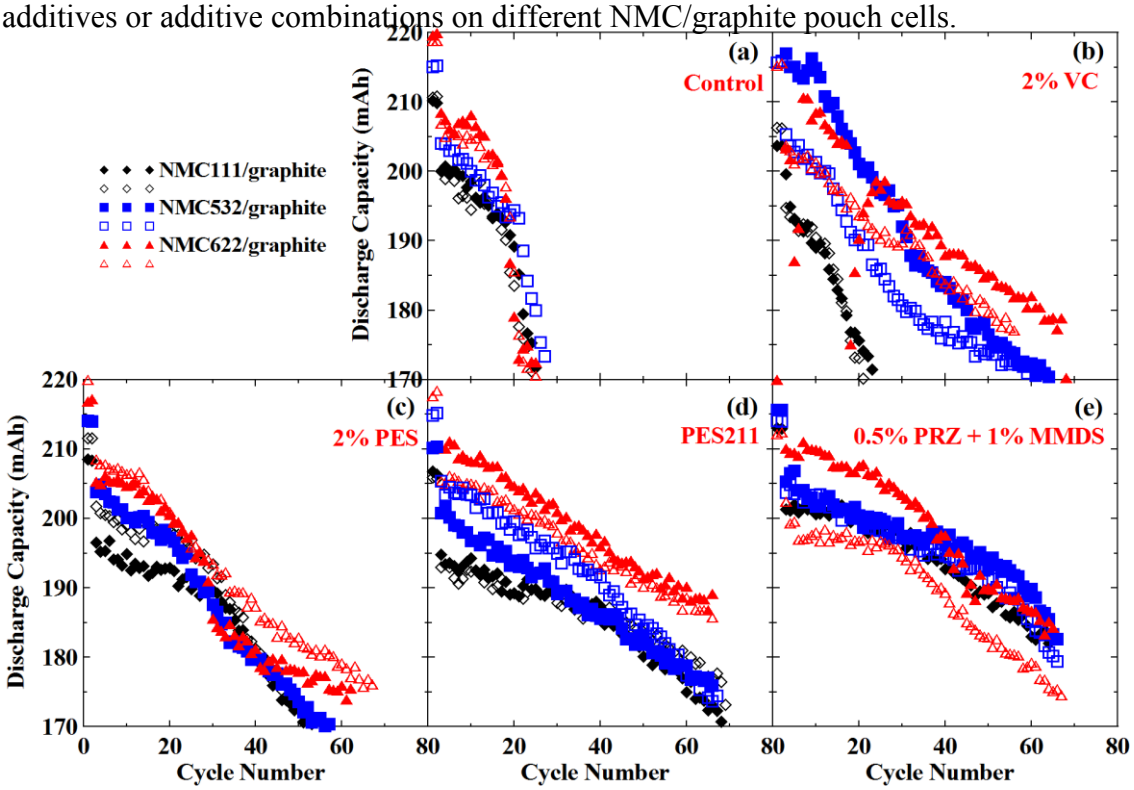

Figure 1. Capacity versus cycle number for NMC/graphite pouch cells with various electrolyte additives as indicated. Cells were charged and discharged between 2.8 and 4.4 V at 40°C at C/5. There was 24 h OCV period at the top of every charge. This is a very aggressive test. Notice that the electrolyte additive blends "PES211" and PRZ + MMDS are effective for every NMC grade while VC is only effective in this test for the highest Ni content grade (NMC622).