Highly concentrated electrolytes have many unique properties, such as Li+-intercalation into graphite anode without EC, suppression of S\textsubscript{8} ion dissolution in Li-S batteries, etc., and is attracting much attention of many researchers. In highly concentrated electrolytes, all solvent molecules are strongly coordinated with Li\textsuperscript{+} ions, and hence the stability of the electrolytes against oxidation is improved significantly. Yoshida et al. reported that LiCoO\textsubscript{2}, which is a 4-V cathode, can be charged and discharged in a LiTFSI/triglyme (1:1) electrolyte with good cycleability, though triglyme is an ether compound and usually cannot be used as solvent. 5-V cathodes, e.g. LiNi\textsubscript{0.5}Mn\textsubscript{1.5}O\textsubscript{4} and LiCoPO\textsubscript{4}, are promising for the next-generation LIBs with high energy densities. Unfortunately no electrolyte systems that tolerate the highly oxidative 5 V cathode have been reported so far. In the present study, we investigated the effect of concentration on the stability of highly concentrated electrolytes, LiPF\textsubscript{6}/PC and LiBF\textsubscript{4}/PC, against a 5-V cathode, LiNi\textsubscript{0.5}Mn\textsubscript{1.5}O\textsubscript{4} to realize 5-V LIBs with high energy densities.

Figure 1 compares charge/discharge curves of a 5-V spinel LiNi\textsubscript{0.5}Mn\textsubscript{1.5}O\textsubscript{4} in standard (0.83 mol kg\textsuperscript{-1}, 1 M, Li/PC = 11.8) and highly concentrated (4.9 mol kg\textsuperscript{-1}, Li/PC = 2) LiBF\textsubscript{4}/PC at 30°C. The charge/discharge rate of C/10 was employed to emphasize electrolyte decomposition. Thought the LiNi\textsubscript{0.5}Mn\textsubscript{1.5}O\textsubscript{4} can be charged and discharged in both electrolytes, the irreversible capacity (Q\textsubscript{irr}) in 1 M LiBF\textsubscript{4}/PC was high (76 mAh g\textsuperscript{-1}) because of vigorous electrolyte decomposition. In contrast, Q\textsubscript{irr} was significantly reduced in the concentrated electrolyte, which indicated that stability against oxidation was improved in the highly concentrated electrolyte. Similar tendency was also observed in highly concentrated LiPF\textsubscript{6}/PC electrolytes, though polarization on charging and discharging were much higher.

A fresh half-cell was fully charged to 5.0 V, and kept at 60°C for 3 days in LiPF\textsubscript{6}/PC electrolytes. The amount of Mn deposited on lithium counter electrode was evaluated by ICP as a measure of dissolved Mn ions. The amount of dissolved Mn ions decreased with increasing Li/PC ratio, which indicated that the use of highly concentrated electrolytes is also effective for suppressing Mn ion dissolution.

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