Reactive Metal Surfaces in Ionic Liquids

Patrick C. Howlett,[a] Jiazeng Sun,[a] Maria Forsyth,[a] Douglas R. MacFarlane[b]
[a]Department of Materials Engineering, [b]School of Chemistry, Monash University
Clayton Campus, Wellington Road, Clayton, Vic 3800, Australia

An understanding of the solid electrolyte interphase (SEI) that forms on the lithium metal surface is essential to the further development of lithium metal batteries. Currently, the formation of dendrites during cycling, which can lead to catastrophic failure of the cell, has mostly halted research on these devices. The discovery of ionic liquids as electrolytes has rekindled the possibility of safe lithium metal rechargeable batteries. The current limitation of ionic liquid electrolytes, however, is that when compared with conventional non-aqueous electrolytes the device rate capability is limited. Recently, we showed that the addition of a zwitterion such as *N*-methyl-*N*-(butyl sulfonate) pyrrolidinium (Fig. 1) to a *N*-methyl-*N*-propyl pyrrolidinium bis(trifluoromethanesulfonyl)amide ionic liquid electrolyte resulted in the enhancement of the achievable current densities by 100%.[1] It was also shown using impedance spectroscopy that the resistance of the SEI layer in the presence of zwitterion was 50% lower. More recently,[2] a detailed chemical and electrochemical analysis of the SEI that forms in both the presence and absence of zwitterion has been conducted. Clear differences in the chemical nature and also the thickness of the SEI is shown which may account for the enhancement of operating current densities. This paper will describe our work on the use of zwitterionic additives in ionic liquid electrolytes, effectively modifying the SEI, as well as providing a more general review of our work on reactive metal surfaces in ionic liquids.

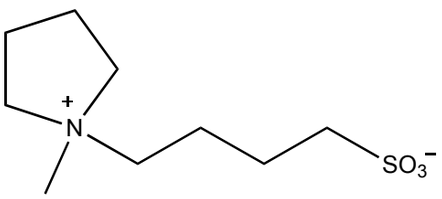

Figure 1. The zwitterion *N*-methyl-*N*-(butyl sulfonate) pyrrolidinium

References

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2. N. Byrne[a], P. C. Howlett, D. R. MacFarlane, M. E. Smith, A. Howes, A. F. Hollenkamp, T. Bastow, P. Hale, M. Forsyth[a], *J. Power Sources*. In Press.