

Safety Performance of Polymer Lithium-Sulfur Cells

Ainsworth D.A, Lilley S.J, Kolosnitsyn V.S and Ivanov G.

Oxis Energy Ltd

D5 Culham Science Centre, Abingdon, Oxfordshire,
OX14 3DB

Email: scott.lilley@oxisenergy.com

Tackling global warming is one of the greatest challenges facing mankind. One of the greatest contributors to global carbon dioxide emissions is transportation. In light of this electric vehicles are of considerable interest as they have the potential to run on renewable electricity. At present electric vehicles cannot match the range of conventional vehicles. This is largely due to battery capacity limitations.

The lithium-sulfur (Li-S) battery is an emerging technology that has a high specific energy, potentially allowing the extension of electric vehicle range. Li-S batteries promise to deliver over 3 times the specific energy of lithium-ion cells making them ideal candidates for electric vehicles. This extremely high specific energy is achieved through the use of a lithium metal anode and an elemental sulfur containing cathode.

Recent issues with the overheating of lithium-ion batteries in consumer electronics have raised the profile of battery safety. Within this context the prospect of including highly reactive lithium metal in high energy density batteries may cause concern. With this in mind Oxis Energy Ltd has embarked on a programme aimed at the demonstration of the inherent safety of Li-S chemistry.

Prototype Li-S pouch cells of capacity 500mAh were subject to four industry standard safety tests. Thermal stability; the cells were heated to 150°C and held for 30 minutes; no thermal runaway was observed. Overcharge; the cells were charged to double their open circuit voltage and held for 24 hours. During the overcharge test the cell temperature did not rise by more than 3°C above ambient at any point on the cells surface. Both of these tests were destructive, but no fire or explosion occurred. The remaining two tests were nail penetration and external short circuit (Fig.1).

It can be seen that during the period of the short circuit the mean cell surface temperature increased by approximately 15°C before cooling back to ambient temperature. This was the case at all measurement points on the cells surface. A similar result was achieved for the nail penetration test. There was no explosion or fire and in both tests the cells recovered their open circuit voltage. The cells could even be cycled after testing (Fig.2).

The unique polysulfide cell chemistry has enabled the Li-S batteries to show robust safety performance. This gives considerable cause for optimism.

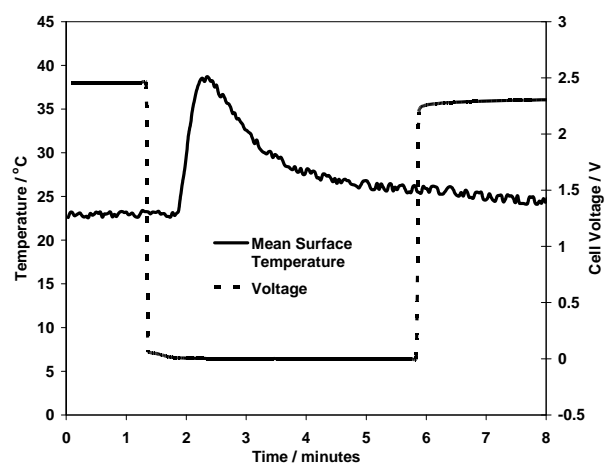


Fig.1: Voltage and temperature profile of a short circuited Li-S battery.

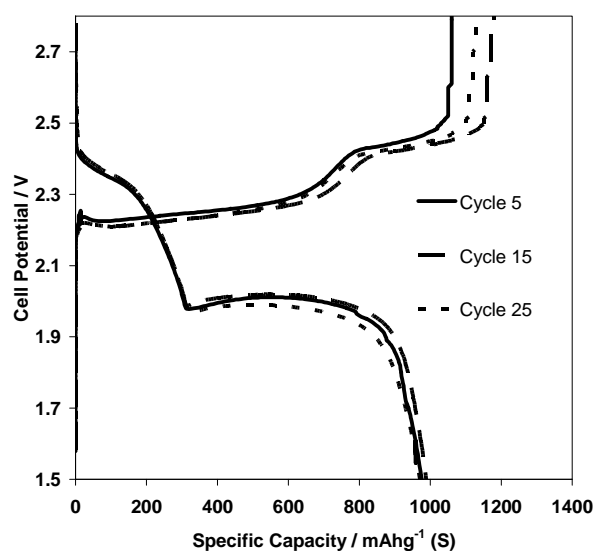


Fig. 2: Charge/Discharge profiles of polymer Li-S battery after short circuit test.