ULTRASONIC MONITORING OF LONG-TERM CYCLING AND DEGRADATION OF LITHIUM-ION BATTERIES

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ABSTRACT
The move to renewable energy sources requires the storage of generated energy in order to meet current and future demands. The use of batteries as a storage method demands the increase in energy and power density, along with the longevity of the cells to reliably accommodate for grid fluctuations. Lithium-ion chemistries are the most prevalent battery technology but are prone to performance variation at different charge rates. The accurate monitoring of the ageing behaviour of lithium-ion batteries is a requirement for the advancement of battery safety monitoring and management.

This work utilised a non-destructive technique of detecting the internal changes to the mechanical structure using acoustic imaging. The responses of an ultrasonic pulse of two batteries over 100 charge cycles were analysed, specifically the acoustic time-of-flight, and compared to the drop in state of health. The capacity difference was used as the basis for the state of health estimations. The main ageing mechanism was confirmed to be loss of lithium inventory, proved by the deployment of incremental capacity plots.

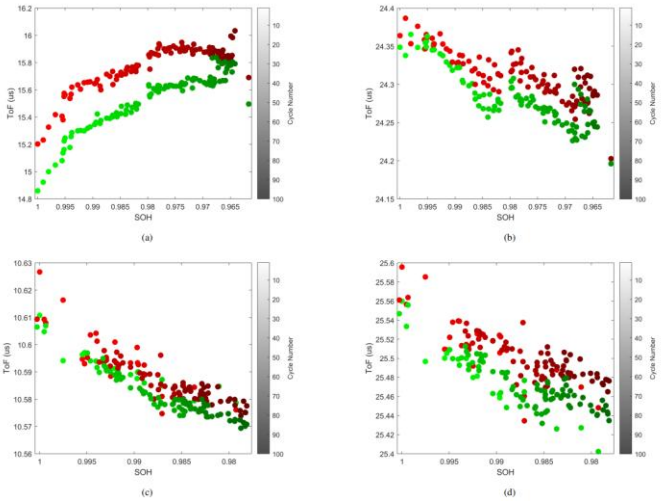

Fig.1 Comparison of four acoustic peaks as the state of health of two batteries drop over 100 cycles. Plots a) and b) are for battery 1 and plots c) and d) are for battery 2. The green dots represent a state of charge of 100% and the red dots represent a state of charge of 0%. The hue of the dots represents the cycle number: the hue darkens as the cycle number increases.

REFERENCES
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