

Ultrasonic monitoring charge/discharge degradation of lithium polymer battery cell

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To monitor the performance and reliability of a lithium-ion battery during charge/discharge cycles, an ultrasonic time-of-flight (ToF) and attenuation measurement was performed. A pouch type commercial lithium-ion battery was used for this investigation. this battery material consists of a cathode of LiCoO₂, Anode of graphite and a polypropylene separator. A charge/discharge cyclic test was performed in a voltage range of 3.0-4.2V at a rate of 0.3C. A piezoelectric longitudinal ultrasonic sensor was used to Ultrasonic pulse-echo monitoring. Ultrasonic ToF of the reflected pulse echo increased with the decrease in the state of charge (SoC). and the ToF value increased with number of charge/discharge cycles, which can be attributed to elastic degradation of the electrode material. On the other hand, the signal amplitude decreased with the increasing cycles, implying that the energy of the initially transmitted wave pulse was dissipated by the material damage induced during the repeated use. A health evaluation map relating SoC with ToF at various cycles(1/20/30/40cycle) was constructed. In this map, ultrasonic hysteresis was reported, of which area reflected the magnitude of irreversible electrochemical damage to the battery material. A linear correlation between the ToF and the number of cycles was observed. This linear correlation a feasibility of ultrasonic ToF measurement to be applied for monitoring the degree of battery degradation.