Monitoring charge/discharge damage evolutions in lithium ion battery cell by acoustic emission signal analysis

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The Acoustic Emission (AE) technique has been explored as a method for assessing charge/discharge-induced damage in lithium-ion batteries. In this investigation, the degradation phenomena associated with the silicon (Si) electrode in a lithium-ion battery were examined through in-situ AE signals recorded during an accelerated charge/discharge cyclic test. The acoustic sensor successfully detected the number of AE signals throughout the charge/discharge cycles. Significantly, an increased occurrence of AE hits was observed during the discharge process with cycles, indicating that the damage to the Si active material electrode predominantly takes place during this phase. The identified AE signals were categorized into two distinct types, namely type 1 and type 2, based on AE waveform parameters, including duration and amplitude. The type 1 signal exhibited a short duration and high amplitude for its main frequency component, while type 2 signals had a long duration and low amplitude. It is suggested that the active AE sources for type 1 and type 2 signals could be attributed to micro-cracking of the Si active material and the formation of gas bubbles accompanied by Solid Electrolyte Interphase (SEI) layer development on the electrode surface, respectively. These findings underscore the viability of the AE technique in evaluating the charge/discharge degradation of the Si electrode in a lithium-ion battery, providing valuable insights into the underlying mechanisms of electrode damage and supporting advancements in battery technology.