

Lithium-ion cells: Integrated vibration and temperature testing

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Abstract

The electrodes of lithium-ion cells (LICs) are separated by a separator material consisting of polymers. It has been reported that when batteries are subjected to dynamic loading conditions, such as vibrations, the LICs can suffer structural issues such as the separation of electrodes and the deformation of separators [1,2]. For example, electrode cracks and structural deformation can reduce the electrochemical performance of LICs. These problems raise internal resistance and lead to localized heat generation [3]. A recent study indicated that the vibrations cause temperature variations on the LIC external surface (approximate fluctuations of 5 – 10 °C) [4]. As a result, thermal management becomes more complicated, LIC aging accelerates, and safety risks arise, including short circuits and thermal runaways. To tackle these challenges, we need more realistic testing protocols that consider the combined effects of vibrations, temperature, humidity, and mechanical stress of both individual cells and packs. Moreover, smart cell protection circuits need to be designed for specific applications. Here, we describe a versatile setup in which LICs' performance (charging and discharging, including full and micro-cycles) can be tested under mechanical vibration conditions at different temperatures. A random vibration profile, referenced to existing industry standards, is mainly used to simulate real-life vibration scenarios experienced by the LICs.

References

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