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Chapter three - Weldability appraisement of dissimilar metal joints: application of ultrasonic spot welding to Li-ion batteries

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Abstract

Energy crisis poses a major challenge in the modern industrial scenario. Electrification of automotive may provide a potential solution to this problem. The performance of the battery electric vehicles mainly depends on the energy capacity of batteries. In this regard, the lithium-ion (Li-ion) batteries grab a great deal of attention due to its high energy storing capacity as compared with conventional lead-acid batteries. Manufacturing of Li-ion batteries involve a significant amount of joining to reduce the power loss and gain of desired power during the transmission process. Thus, a conservative and energy-efficient method is necessary. However, the joining of these highly conductive dissimilar metals using any other conventional welding processes such as resistance spot welding and laser welding is extremely challenging due to varying physical, chemical, and thermal properties, the formation of the heat-affected zone and intermetallic compounds. Recently, ultrasonic spot welding (USW) process is widely adopted for assembling the Li-ion battery packs and its modules. Moreover, this technique yields better quality welds under the influence of optimal parametric conditions. Despite having the solid-state nature of USW and availability of past literature, the fundamental mechanism during the process is still uncertain. Furthermore, there is a lack of scientific understanding in implementing the USW process in mass production. The research work explores the effect of different welding parameters like weld time, weld energy, weld pressure, and vibration amplitudes with a fixed ultrasonic frequency of 20 kHz for joining various dissimilar sheets.

characterization of this process and various joint qualities are identified at several weld parameters. Additionally, the microhardness measurement at the welded area is also revealed. This study not only imparts new knowledge but also provides an insight to enhance the reliability and quality of the USW process related to Li-ion battery manufacturing.

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Keywords

Lithium-ion battery; ultrasonic spot welding; tensile shear strength; microstructural characterization; intermetallic compound; microhardness

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