



Looking into the effects of mechanical stress on Li-ion batteries for vehicles

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There is a growing interest in mechanical stress upon Li-ion batteries during its lifetime, especially for the automotive and heavy vehicle industry. During its lifetime, a vehicle is exposed to vibration, shock, and a risk for collision. Statistics shows that there is a 6-10% risk of being subject to a collision in Sweden. Most collisions are not severe and therefore the vehicles can be put in service again after repair at the work shop. However, there is a lack of knowledge of how a battery is affected by such an incident. A better understanding about battery failure and safety issues is needed to optimize the use of these batteries considering both safety, economic, and environmental aspects. Further research to support the development of standardization requirements is also needed. There are a number of standards for mechanical testing of lithium-ion batteries. These standards are mostly based on previous experiences of other vehicle equipment and not adjusted to the construction or attachment of a battery. A battery pack is a mechanically complex system with small electronic components, arrays of cells, and integrated cooling system mounted in a larger construction. This kind of construction should undergo a vibration test that contains a wide frequency content well above 200 Hz. This is not consistent with many of the existing standards today. Furthermore, field measurements in an electric car shows that resonance frequencies differ from what is obtained in a gasoline vehicle and that the vibration levels could be more severe than what is tested for in lifetime tests applied in standards. Initial tests have been performed on battery modules where they have been exposed to both moderate vibration levels, and shock levels up to 35 G. The main research on batteries today focuses on energy efficiency where the analysis is often based on the changes in capacity. These results show no change in capacity. Instead there are indications that the internal resistance changes. The effect on internal resistance varies over time after the shock treatment and might not show immediately after the test. This is a research area which needs more attention.

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