Multi-scale simulation of laser welding for optimal battery pack manufacturing

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Battery production for started about ten years ago when manufacturers got serious about creating electric vehicles that could handle highway driving and longer distances. Now that everyone wants better energy solutions, companies need high-quality electric parts that function as promised. Short development windows haven't given the industry enough time to perfect these processes. Our project tackles this by examining how battery components, specifically busbar to battery tab, are joined together. From individual cells all the way to complete battery packs. We focus on laser welding as a joining method, since it's the industry standard. We analyze structural integrity, electrical resistance problems, electrochemical composition as well as phenomena related to charge/discharge under different temperature conditions.

The simulations we developed gives manufacturers a practical tool that can be used to study different scenarios while developing battery packs and fine-tune their laser settings and joining techniques. This means more efficient batteries, more efficient production, and higher quality overall—exactly what the growing electric vehicle market needs right now.

One outcome of the project is an application, where individual battery cells as well as full battery packs can be evaluated in terms of degradation during charging/discharging for various temperature conditions. Other outcomes include laser process parameters and other settings to be used during assembly of the battery modules and battery packs. These are settings are integrated in the application and govern for example the electrical resistance under operation.

The poster illustrates the proposed strategy and results related to the modeling of charge/discharge of battery packs.