Laser micro-joining feasibility study using dissimilar materials for electric vehicle battery interconnects

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Lithium-ion based secondary battery packs are emerging as an alternative power source and are being increasingly used in Electric Vehicles (EVs), Hybrid or Plug-in Hybrid Electric Vehicles (HEVs/PHEVs). Increasing uptake of such vehicles requires development and improvement of battery pack manufacturing methods to meet the demand. Lithium-ion battery packs used for electric vehicles and their variants commonly contain hundreds or even thousands of cells which are connected in series and/or parallel to deliver the required power and capacity [1,2]. This triggers the need for suitable joining methods capable of providing mechanical strength together with the required electrical and thermal performance. A range of joining techniques are currently employed to connect large numbers of cells, and of these, laser welding is estimated to be the one of most efficient methods [1].

Copper, aluminium and electrical grade stainless steel are the traditional materials used for tab-to-busbar and tab-to-cell terminal connection. This study focuses on the feasibility of joining study considering a copper tab to a steel terminal connection (i.e. representative of cylindrical cell terminal to tab interconnect), and aluminium busbar to copper tab connection using a 150 W Quasi-CW IR laser. Joining feasibility is assessed by evaluating the lap shear and T-peel strength of the joint, microstructural characteristics (i.e. penetration depth, interface width), scanning electron micrographs (SEM), and microhardness across the joint. In general, lap shear strength is four to seven times higher than the T-peel strength obtained from identical laser process parameters. Optical and SEM micrographs reveal the microstructural characteristics of the joint whereas microhardness distributions provide an indication on the mechanical characteristics about the base material, heat affected zone and fusion zone.

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