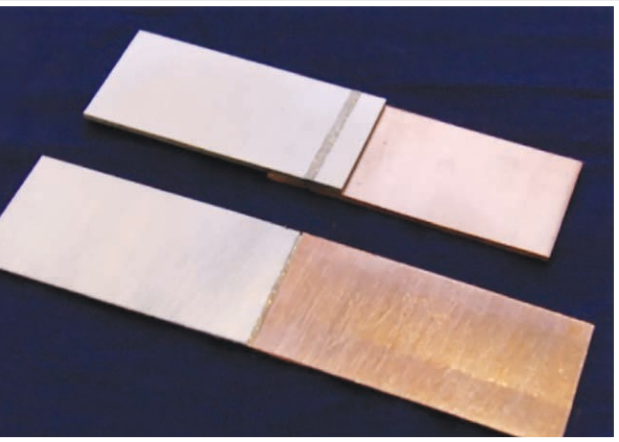
Fraunhofer
USA
Center for Laser Applications

Making Light Work

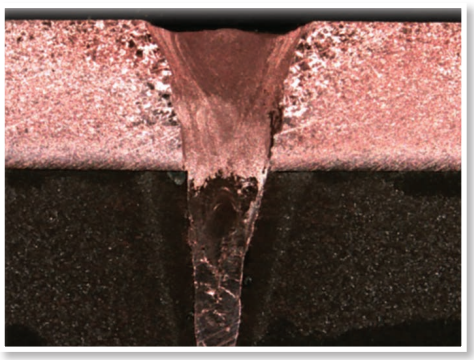


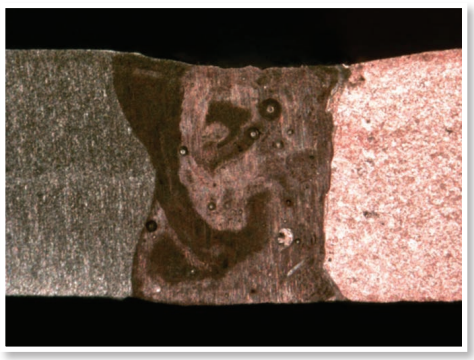
Aluminum/Copper Weld Samples (1.0mm Thick)

Welding Dissimilar Metals

Laser beam welding processes are well suited to cost effectively fabricate dissimilar material joints. Laser processes can efficiently join material combinations such as Copper and Steel, Aluminum and Steel, Nickel and Steel, Nickel and Copper and can also be considered for Copper to Aluminum joints. Fraunhofer CLA has several state of the art high beam quality laser sources from 5kW to 10kW output power with beam delivery fibers as small as 100 microns (0.1mm) which enable extremely small and precise welds to be made without excessive heating of the surrounding components. These lasers can be used to generate extremely narrow weld seams even on reflective materials such as Copper and Aluminum. Due to the reduced melt lifetimes associated with the laser process, the heat input into the part is significantly reduced, which limits the formation of brittle inter-metallic phases formed during welding. It is a general requirement to manufacture components with optimized weight and performance properties. The capability to weld combinations of different materials enables performance properties to be optimized.

Laser Welding 6.0mm (1/4") Thick Copper





(far left)
Cross Section –
Copper/Steel Overlap Joint
(0.5/1.0mm)

(immediate left)
Cross Section –
Aluminum/Copper Butt Joint
(1 mm thickness)

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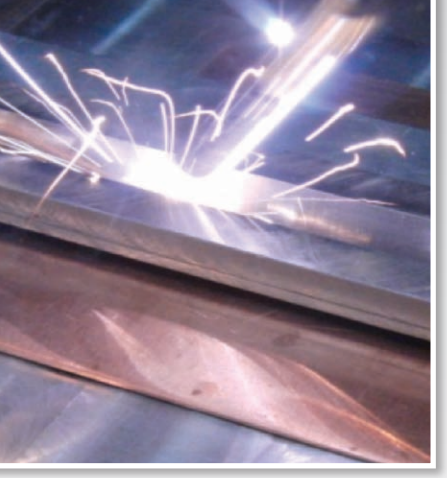


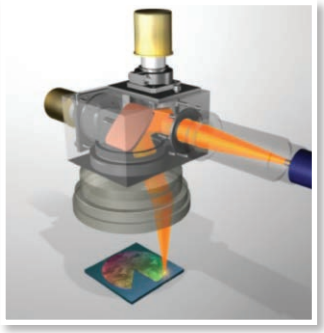
Laser Welding of Copper

Battery Welding

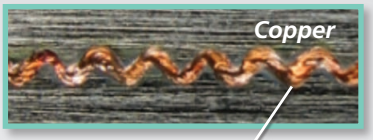
Laser welding is fast and precise, and repeatable high weld quality can be achieved. Fraunhofer CLA has successfully developed laser welding processes for a wide range of Lithium-Ion battery welding applications and has helped to transfer these into volume production. For high performance applications such as for electric vehicles, single Li-Ion cells are combined into large modules and packs, in which the terminal(s) of a single cell or multiple cells are connected to the terminal(s) of the next cell(s) via a metal bus bar.

Typically our lasers can produce welded connections between the bus bar and the cell terminals using either overlap or butt joint configurations. Laser welds have excellent electrical and mechanical properties making them ideal for this application.

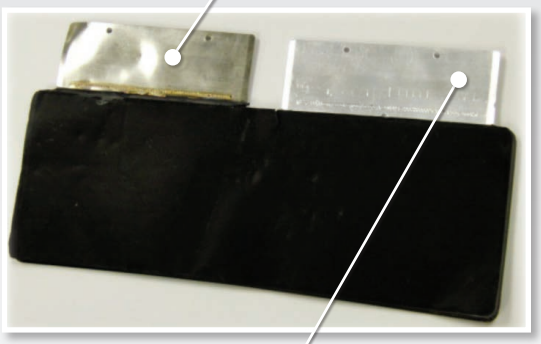
Laser Welding of Copper and Aluminum



Fraunhofer has also developed a Laser welding process using a highly dynamic beam scanning unit in order to significantly improve the quality of laser welded dissimilar joint combinations of Copper and Aluminum, Copper and Stainless Steel, and Aluminum and Magnesium. The laser beam is rapidly scanned along and across the weld joint using moving mirrors. During the process, the laser beam power is manipulated, which improves the degree of material mixing and also affects the melt turbulences. Remote welding also enables scanning of the laser beam to produce the desired weld shape, such as small diameter circular welds for terminal to bus bar connections.



Laser Welds for Joining Foils to Terminals



Electrodes with Laser Welded Tabs

Laser Welding of Anode and Cathode Foils

Currently, foils of the anode and cathode respectively, are welded to each other using Ultrasonic welding. The potential of cracking and insufficient penetration caused by process instability and wear of the sonotrode reduces the conductivity of these joints. Fraunhofer has developed a laser welding process which joins the foils with consistent high weld quality. The laser welded joints exhibits a significantly higher electrical conductivity compared to Ultrasonic welding.

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