SigmaClad® LASER Weldability

SigmaClad® is a five-layer material system that has been specifically developed for li-ion cylindrical cell battery pack connector applications (cell connector or current collectors). Each layer serves a specific function making SigmaClad® and ideal choice for cell connectors.

* Nickel layer: Provides enhanced corrosion protection and a solderable surface.
* Stainless Steel: Adds mechanical strength and is excellent for resistance welding.
* Copper layer: Optimizes both thermal and electrical conductivity for keeping the pack’s operating temperatures as low and uniform as possible.

These key characteristics make SigmaClad® easy to apply while keeping the battery pack temperature low and uniform as compared to mono-metals connector materials.

SigmaClad® has been widely accepted for its superior resistance welding characteristics. However, some customers have indicated the desire to LASER weld for the following reasons.

1. Single plane pack manufacturing where the pack is configured to weld only on one side eliminating the need to flip over the pack and add a second cell connector. This typically requires a li-ion cylindrical cell to have a larger side wall (or rim) for the negative connection.
2. Large volume productivity improvements. Since LASER welding is much faster than resistance welding, large volume packs can take advantage of the faster speeds.

This paper addresses the topic of LASER welding SigmaClad by reviewing existing production LASER welding of SigmaClad to itself and to copper buss bars as well as lab testing to cylindrical cells.

**Production LASER welds**

The cross sections below are from high volume production packs that are LASER welding SigmaClad to various bus bar components. Based on visual inspection and peel testing, all welds meet our customers’ requirements.

A close-up of a grey object

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Photo 1: Etched 200X- 0.30 mm SC40 LASER Welded to Copper

A close-up of a bench

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Photo 2: Etched 200X - 0.30 mm SC40 LASER Welded to 0.30 mm SC40

A close-up of a grey and brown surface

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Photo 3: Etched 500X- 0.30 mm SC40 LASER Welded to 0.30 mm SC40

**Battery Cell LASER welds – LAB testing**

The photographs and cross sections below are from LASER welding trials of 0.50 mm SC60 welded to both the positive and negative sections if 21700 cells.

A diagram of a positive tab

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Illustration of 21700 Cell show tab locations for LASER welding

A close-up of a metal ring

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Photo 4: SC60 Positive tab LASER weld to 21700 cell

A close up of a line

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Photo 5: Cross section of SC60 Positive tab LASER weld to 21700 cell

A close-up of a painting

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Photo 6: Cross section at high magnification of SC60 Positive tab LASER weld to 21700 cell

A battery with a metal lid

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Photo 7: Peel test samples

**A close up of a metal object

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Photo 8: SC60 LASER welded to both positive and negative tab

A close-up of a blue surface

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Photo 9: Negative Tab LASER Weld – 0.50 mm SC60 welded to 21700 cell case

Note: Although the cells negative case rim is not flat, we were able to obtain good welds with peel strength above 300N. Special cells are available with flatter case tops for LASER welding to the cells negative top cripped section if required.

Based on the microscopy, which did not show any cracking or voids, and the exceptional peel test results, we have shown that SigmaClad® can be LASER welded with good weld quality to both the positive and negative sides of a standard 21700 cell.

**Summary**

SigmaClad was initially developed for resistance welding to cylindrical cells as an alternative to nickel and copper alloy tabs. SigmaClad® has gained excellent resistance welding market acceptance due to its superior weld performance coupled with high electrical and thermal conductivity resulting in low pack temperatures.

SigmaClad® is currently being LASER welded to various buss bar components in high production volume with good quality results. SigmaClad® has also been evaluated for cylindrical cell welding with very good results. SigmaClad has been successfully LASER welded to both the positive and negative sides of 21700 cells. This will allow customers that are interested in using SigmaClad® with a LASER welding processes to benefit from its solderability, high thermal conductivity, high mechanical strength, and weldability.

Please contact Engineered Materials Solutions to find out more about LASER welding SigmaClad.