TELSONIC
ULTRASONICS

Ultrasonics and electromobility – a powerful combination

Efficient, powerful, reliable, connected and eco-friendly

PLASTIC WELDING | METAL WELDING | CUTTING | CLEANING | SIEVING

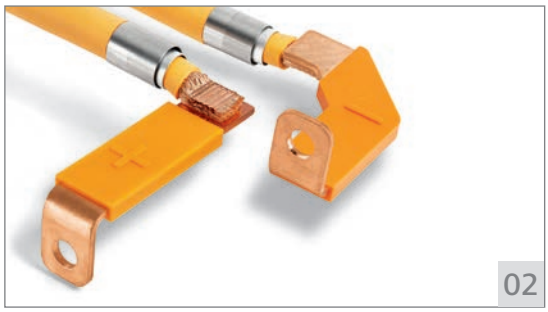
Bronschhofen (CH), 04/2020

Electromobility is now regarded as the key to climate-friendly driving practices, because electric vehicles generate significantly less carbon dioxide per kilometer than vehicles with conventional combustion engines – especially in combination with electricity generated from renewable sources. At the same time, the energy storage systems used by electric vehicles can compensate for fluctuations in the electricity grid by means of wind and solar power, thereby supporting the expansion and market integration of these energy sources. However, the automotive industry is now facing new challenges which need to be addressed in an innovative manner. This also applies to the manufacturing technologies that are required for all aspects of electromobility, from lightweight body construction to the electrical and electronic components and battery production. Processes that use ultrasonics open up interesting possibilities with regard to quality and also from an economic and ecological point of view.

Ultrasonic-based processes and electric vehicles have much in common: Efficiency, performance capability, reliability, connectivity and eco-friendliness are among the essential characteristics that they both possess.

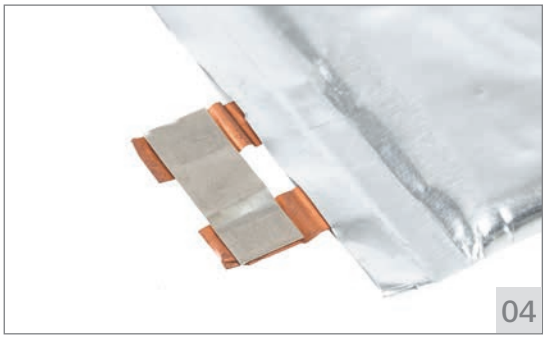
Efficient - Ultrasonic sieving in battery production

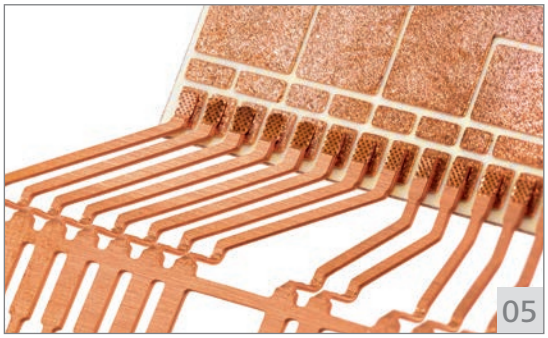
Electric vehicles are optimized for efficiency due to the transparency of accurate



01 Ultrasonic sieving during battery production

02 High voltage cables for the high voltage connections in a vehicle





03 High-voltage cables connect the charge controller to the charging socket and/or the charger to the charging plug

04 Connecting the conductors of a pouch battery

05 Conductor connections of an IGBT on a ceramic substrate

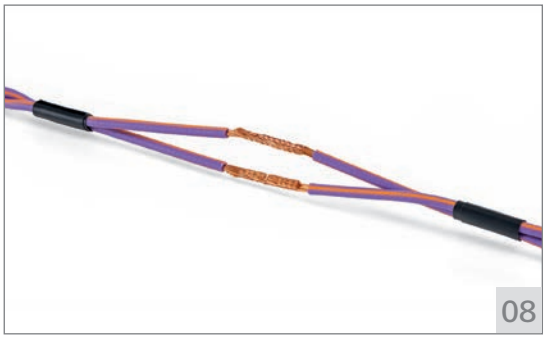
06 Aluminum busbars with a 360 degree welded mounting bolt (Author: Abele Ingenieure GmbH)

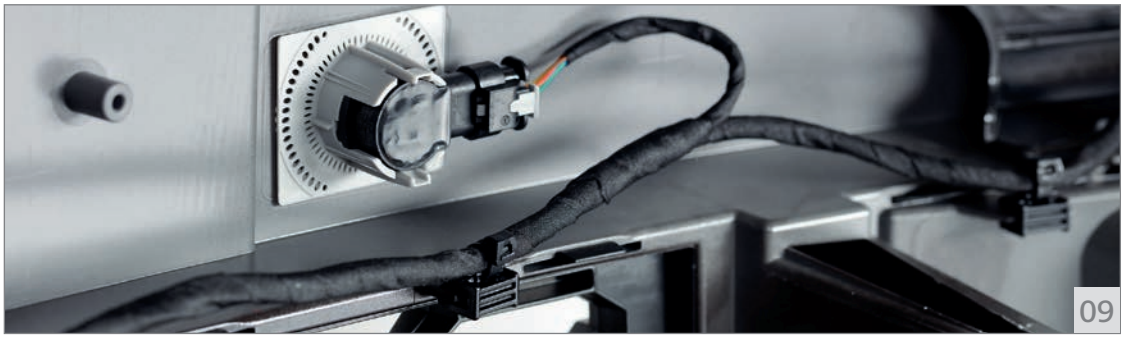
consumption measurements. From battery to drive train, air resistance and the rolling friction of the tires, close attention is paid to the level of efficiency. Efficiency also plays an important part in ultrasonic processes. Thanks to its extensive experience in sieving, Swiss ultrasonic specialist Telsonic is involved in the key process of battery production right from the very beginning: Sieves stimulated with ultrasonics reduce friction during the separation of powdered battery materials. This reliable and energy-efficient process technology (Fig. 1) improves selectivity and therefore provides very homogeneous powder consistency for manufacturing the electrodes of vehicle batteries. Ultrasonically stimulated double-decker sieves with precisely defined mesh sizes are often used in practice. This allows the carbon for the anode and the lithium metal oxide for the cathode to be separated with a high degree of selectivity, and outsize grains are reliably removed. These quality characteristics are essential for subsequent processes in which the powder is mixed into a paste with water and solvent and must be applied to the electrode carrier films in an extremely homogeneous way.

Powerful – reliable contacting of high-voltage conductors, battery films and high-performance electronics

Electric motors provide full power from a standstill. They do not need to be warmed up or brought to a certain speed to give maximum performance. This also applies to ultrasonic processes. These also deliver immediate performance and make short cycle times possible. A typical example is reliable welding of copper, aluminum or any combination thereof for high-voltage connections in vehicles, for example (Fig. 2). Charging cables with plugs (Fig. 3) that run from the charging station to the high-voltage battery make rapid charging possible, even under difficult conditions, whereby a reliable connection with low contact resistance is important. A cable with a cross-section of 70, 95 or 120 mm^2 must be securely welded to a high-current contact for this purpose. Designers demand a welding width that is as narrow as possible to save space. That which was previously difficult to solve with conventional processes can now be realized with the PowerWheel® technology, which reliably connects the cable to the high current contact within a short time using a powerful influx of energy.

Contacts between the individual aluminum and copper films of the pouch cells of a high-voltage battery and the arresters for the external connections are welded quickly, reliably and with high quality using ultrasonics (Fig. 4).





07 Telso®Splice TS3 with multi-conductor high-voltage cable.

08 Connection of twisted wires for high data transfer rates

09 Sensor holder welded to the inside of a bumper using ultrasonics

A central electronic component for converters of electrical drives and battery charging systems are IGBT power semiconductors, which are capable of switching electrical currents quickly and with minimal losses. The unique torsional welding technique SONIQTWIST®, which uses slim sonotrodes that approach from above, is particularly suitable for the sensitive ceramic substrates of the IGBTs (Fig. 5) onto which the contacts are welded. SONIQTWIST® is perfect for cylindrical welding. Rotationally symmetrical sonotrodes can be used for round bolts, rings or screws, which is not possible with any other process. This technique allows automotive suppliers, for example, to weld a steel bolt pressed into a copper-nickel sleeve to the front end of an aluminum busbar as a contact (Fig. 6). In this case, the weld is made 360° around the sleeve without any interruptions. This provides short cycle times and high productivity when integrated into a fully automated system.

Reliable: Wire splicing for electrical connections

Electric vehicles have a minimal number of moving parts, which significantly reduces maintenance costs and increases reliability. Ultrasonic welding systems are also extremely low-maintenance. Wire splicing with ultrasonics is therefore the solution of choice whenever reliable electrical connections are required to fulfil the high quality standards of the automotive industry, for example. The cables must have perfect connections in order to function reliably throughout the life of a vehicle. In these cases, ultrasonic connections have both financial and technical advantages, including cost efficiency, low electrical contact resistance and high strength in the vicinity of the conductor material. Some extremely flexible welding systems are now available for fulfilling the various requirements in production (Fig. 7). This means that even very thin cables with a cross-section of 0.13 mm^2 and twisted cables (Fig. 8) for high data transfer rates can be welded using the relevant tools.

Connected: Integrated in a higher-level production system

Electric vehicles are digital. The optimal route is calculated based on the battery charge level, driving style, traffic and other environmental conditions. Ultrasonic processes can also be digitally adapted to the respective application, i.e. optimally designed. Wire splicing with ultrasonics has therefore proven to be highly reliable and safe in practice, because the relevant parameters can be adjusted and monitored in an application-specific way. The control and operating software of the Telso®Splice welding systems provides integration and networking options that are fit for the future, together with numerous functions for effective quality assurance. The wire

splicing systems can be connected directly to production management systems, giving users a significant amount of added value. This primarily applies to the most popular MES in the sector, 4Wire CAO by DiIT / Schleuniger. However, integration into other MES systems is also simple via the flexible Telso®CON interface. Thanks to the OPC UA architecture, process control and parameterization of intelligent benchtop systems with a degree of automation of up to 100% is possible.

10 Andreas Hutterli, Product Manager, TELSONIC AG

Eco-friendly: Joining technology for lightweight construction

Ultrasonic technology plays a key role in lightweight automotive construction, an area in which new materials and thin-wall technology which are ideally suited for the SONIQTWIST® ultrasonic welding technology are used. This patented and gentle welding process makes it possible to significantly reduce the wall thickness of vehicle bumpers, for example (to approx. 2 mm) without leaving visible marks on the Class A surfaces of pre-painted vehicle parts. Ultrasonic technology thereby makes a significant contribution to reducing the weight of the vehicle, since it allows materials as thin as this to be used (Fig. 9). The fact that no adhesives or other consumables are required is another analogy to electromobility: electric vehicles do not burn endless quantities of fuel and can be operated with renewable energy, making them eco-friendly.

Ultrasonic-based manufacturing processes, electromobility or the automotive sector of the future in general will be closely linked and will benefit from each another. It is therefore advisable to involve ultrasonic specialists at an early stage of the design phase.

by Andreas Hutterli, Product Manager, TELSONIC AG (Switzerland)