

ENERGY

MANUFACTURING





batteries & storage

Ultrasonic metal welders offer environmentally friendly assembly method for next-generation energy storage



Photo courtesy of Sonobond Ultrasonics

Sonobond's ultrasonic metal welders are configured to be conducive for custom tooling. These modifications accommodate specific configuration requirements, including those needed to assemble rechargeable batteries used to store electrical energy from alternative and conventional sources.

High-Wattage Sound System Has the Joint Rocking

Innovative battery manufacturers are responding to the growing need for affordable and efficient solutions for renewable energy storage. To accommodate the demand, they are using reliable, cost-effective and environmentally friendly ultrasonic technology to assemble their products.

"Currently, wind and solar account for only about 6% of the United States' electrical power generation. But, as reliance on alternative sources of energy increases, storage batteries will become essential as backup, providing power when there is no wind or sun," said Janet Devine, president of Sonobond Ultrasonics (West Chester, PA). "In fact, some battery manufacturers are already developing new formats for home and utility-sized energy

storage systems that could eventually make wind and solar more consistent power resources.

"Some manufacturers hoping to commercialize new types of rechargeable batteries—which may eventually provide backup power, as well as grid-scale distributive storage to maintain peak power—are already employing Sonobond's ultrasonic assembly technology," noted Devine. "Additionally, we continue to supply welding units to manufacturers seeking environmentally friendly methods for assembling existing lithium-ion and NiMH rechargeable batteries used in applications such as all-electric and hybrid automobiles, cell phones and computer tablets, medical technology, and for use in the military and telecommunication fields."



As the percentage of wind- and solar-generated electricity climbs to the realm of 20–30% in the US, the need for battery storage is expected to become critical. In fact, the Joint Center for Energy Storage Research notes that renewable electricity production in Hawaii has already exceeded one-third of its total power production, an achievement that's also causing problems with the state's electrical grid. Large-scale battery storage systems are seen as a “balancing resource” for the grid.

Redesigning Batteries

Battery manufacturers are now designing rechargeable batteries for these stationary electrical energy storage applications, offering a low-cost alternative to lead acid designs. Some battery systems are configured to scale from residential, to commercial, to grid use, offering solutions for power backup, as well as to handle fluctuations in energy use. Ideally, such rechargeable battery systems will be affordable and safe, and improve renewable power quality and reliability by ensuring an uninterrupted power supply.

“Clearly, we want to help these innovative manufacturers achieve their goals by providing the most reliable means of assembling their products,” said Devine.

Sonobond's ultrasonic metal spot-welders can join more layers, without tearing, than any of its competitors, enabling battery manufacturers to increase their production capacity. Plus, these welders are configured to be more conducive to custom tooling, making them adaptable to multiple applications. Additionally, the welders are ideal for environmentally conscious manufacturers since they require no external heat, current, fluxes or fillers, and produce no arcs, sparks or fumes. Instead, the welders employ the company's unique, patented Wedge-Reed ultrasonic bonding system that produces durable joints with better conductivity than other methods and has good repeatability.

Welding with a Wedge-Reed System

Patented in 1960, the Wedge-Reed system was specifically designed for high impedance metal welding. It combines low vibra-

tory amplitude with high vibratory force directed in a shear mode parallel to the interface of the materials to be welded. The shear mode is essential for ultrasonic metal welding.

The Wedge-Reed system uses a vertical, vibrating reed driven by a wedge-shaped coupler and transducer assembly that's perpendicular to the reed. With the line of static clamping force directly above the parts to be welded, high clamp force can be achieved without bending stress or stalling. The result is precise, dependable, solid-state and highly conductive welds. In fact, this system is also the only ultrasonic assembly system that can reliably weld most oxidized and tinned metals in just one pulse without pre-cleaning.



Ultrasonic metal welding technology provides a cost-effective, environmentally friendly method for attaching multiple layers of foil to tabs and terminals used in lithium-ion and NiMH battery assembly. Up to 100 layers of copper and aluminum foils as thin as 7 μm can be welded without tearing, and in just one pulse.

In contrast, other ultrasonic welders use a lateral drive system that combines high vibratory amplitude and low vibratory force, suitable for welding plastics, but is rotated 90° to achieve the shear motion necessary for metal welding. The welding tip is part of—or attached to—a longitudinally vibrating transducer-horn assembly driven parallel to the metals being welded.

“Because of its cantilevered approach, clamping force in a lateral drive system is applied some distance from the weldment, resulting in a bending moment on the coupler that limits static force,” said Devine. While this lateral positioning works for many applications, it does not produce acceptable welds for tinned or oxidized wire and terminals.

Ultrasonic Spot-Welding Equipment

Sonobond offers two ultrasonic spotwelders that weld multiple layers of foils (typically aluminum or nickel-plated copper) to tabs, tabs to tabs, or wire to terminals and also accommodate battery pouch assembly and HV termination welding.

The SonoWeld 1600 can weld foils as thin as 7 μm without tearing, as well as multiple layers of foils to tabs and terminals for lithium-ion and NiMH battery assembly. The unit puts out 1500–2500 W to join nonferrous similar or dissimilar metal assemblies, including copper to aluminum.

The Dual Head Spotwelder features two ultrasonic welding heads, one on either side of the welding area for increased welding

capacity. It is the first ultrasonic welder that can join up to 100 layers of copper or aluminum foils without tearing and in just one pulse. Like the SonoWeld 1600, it can also weld foils as thin as 7 μm . Additionally, the Dual Head Spotwelder can attach wires to terminals; weld non-ferrous sheetmetal, including aluminum, up to 3-mm thick; and accommodate lightly tinned or oxidized wires. The dual head unit uses Sonobond's 3500-W power supply.

Both Sonobond ultrasonic welding units have built-in microprocessor controlled systems that allow automatic frequency control, overload protection, and storage and recall of up to 250 protocols. Digital displays permit selection of welding modes by time, energy or distance. The SonoWeld 1600 and Dual Head Spot Welders employ heat-treated tool steel Taper Lock Tips that can perform up to 30,000 welds before redressing is required and as many as 100,000 welds before being easily removed and replaced. As with all Sonobond equipment, the spotwelders require only minimal training.

Achieving New Electrical Grid Storage Capability

"It's estimated that the market for batteries providing stationary energy storage will increase from about \$1 billion today to approximately \$6 billion by 2020," said Devine. "For battery manufacturers, mechanical fastening is inconsistent, and resistance welding or soldering uses more energy and often produces inadequate bonding. Our ultrasonic method is less expensive; uses a fraction of the energy needed for resistance welding; ensures RoHS compliance, which is problematical with soldering; and speeds the production process.

In addition to assembling newly designed rechargeable batteries, the SonoWeld 1600 Digital Ultrasonic Spotwelder is well suited for manufacturing lithium-ion, NiMH rechargeable batteries and pouch cells.



"Sonobond fully expects to help battery manufacturers keep pace with the growing demand for batteries, which potentially promises to make our energy grid cleaner and more resilient."

To assist battery manufacturers in determining the benefits of ultrasonic welding for their particular applications and requirements, Sonobond offers a free Ultrasonic Welding Viability Test. Using materials provided by the manufacturer, Sonobond produces no-cost, no-obligation sample welds. If Sonobond's equipment is incorporated into the customer's production process, service and technical support is provided before, during and after installation. ↪

Edited by Yearbook Editor James D. Sawyer from information provided by Sonobond.