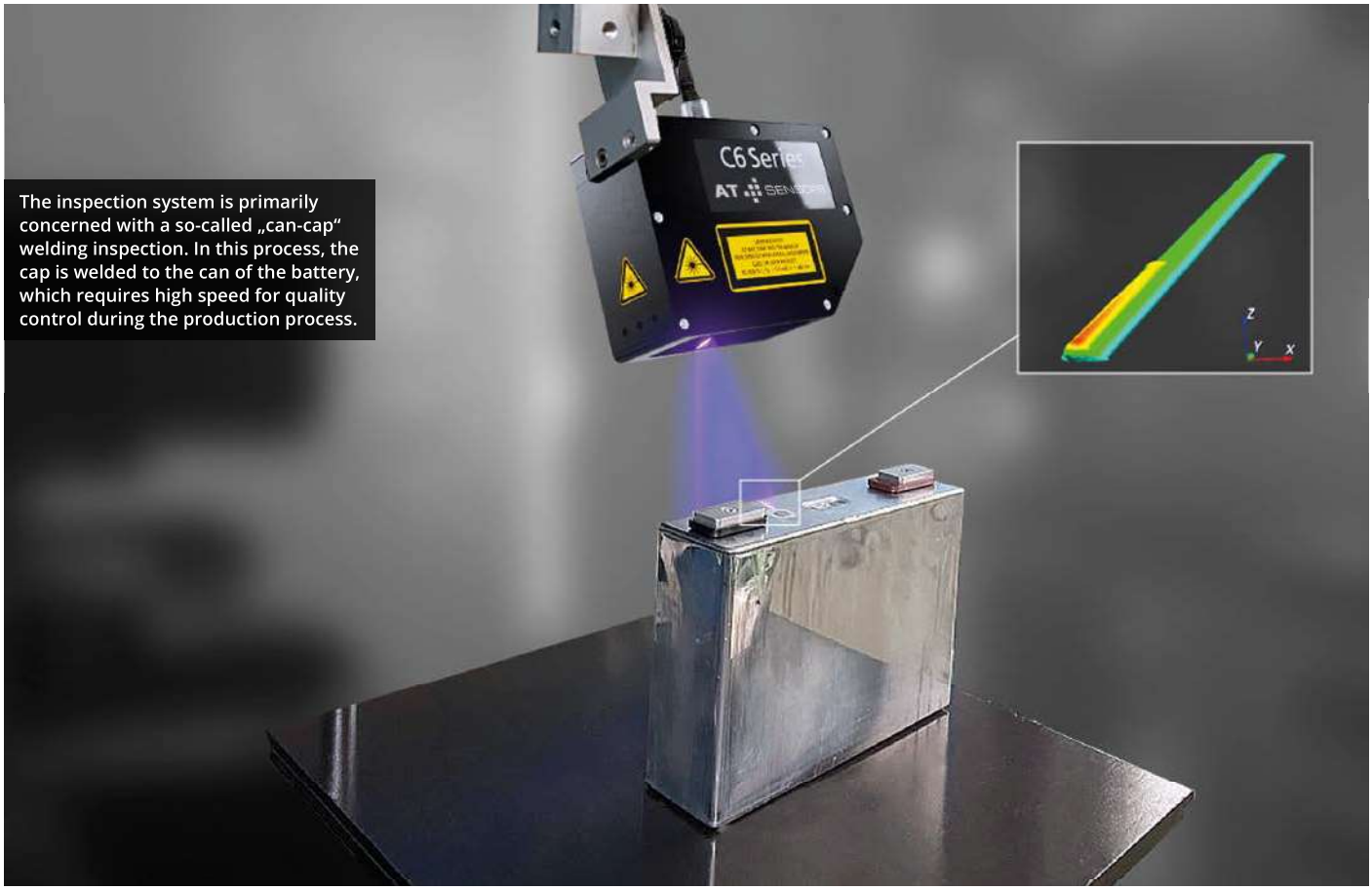

The inspection system is primarily concerned with a so-called „can-cap" welding inspection. In this process, the cap is welded to the can of the battery, which requires high speed for quality control during the production process.

Safety First: How to Make EV Batteries Roadworthy with 3D Sensors

Visual Inspection of Weld Seams of EV Batteries

Electric vehicle (EV) batteries are crucial for powering electric motors, making their quality inspection vital to avoid safety risks like malfunctions and short circuits. A new solution for welding inspection of EV batteries has been developed, focusing on precise and reliable inspection of weld seams. This ensures the structural integrity, safety, and reliability of the batteries, which are essential for their performance and longevity.

Malfunctions, short circuits, chemical leaks: these are all serious safety risks that need to be avoided when it comes to electric vehicle batteries, or EV batteries for short. EV batteries are batteries that have been specially developed for storing energy in electric vehicles (EVs). These batteries are at the heart of electric vehicles, as they store the electrical energy needed to power the electric motor. This makes it all the more important to check the quality of these batteries, as these inspections not only minimize safety risks, but also increase the longevity and efficiency of the products.

This is exactly where the northern German technology company AT – Automation Technology comes into play, which has been developing and producing high-quality 3D components for more than 25 years and belongs to the global players in innovative 3D sensor technology. Together with its sales partner Fainstec, AT has come up with an application solution for the integrator Global Engineering Solutions (GES) in Korea, which involves the welding inspection of EV batteries. GES, which specializes in manufacturing systems for the quality control of electronic and energy components, came into contact with Fainstec as part of a search for a suitable 3D sensor for this very welding inspection. Their requirement: the integration of a product with which the weld seams of EV batteries can not only be scanned and inspected reliably, but above all precisely.

The Welding Inspection Application for EV Batteries

The GES inspection system is primarily concerned with a so-called „can-cap" welding inspection. In this process, the cap is welded to the can of the battery, which not only requires a great deal of precision, but also a high speed for quality control during the production process. The sensor required should be able to detect the smallest defects of just 0.4 mm in size in the weld seam at a speed of 100 mm/s and at the same time take into account convex and concave areas, punched holes and the shape of the weld seam.

„The challenge was not only to provide a fast sensor, but also one that could react flexibly to different requirements such as shape and curvature and deliver reliable scanning results. Thanks to our many years of experience in the machine vision industry and the advantages of our C6 CS series, which impresses in particular with its excellent combination of precision and speed, we were able to offer GES an optimal solution," says Dr. Athinodoros Klipfel, Head of Sales at AT.

The Korean integrator GES therefore uses two AT sensors of type C6-1280CS35-7 GigE (405 nm, class 3R) for can-cap welding inspection. These offer a high resolution in X (5 µm) and Z (0.2 µm) as well as a profiling speed of up to 140 kHz. Furthermore, the C6 1280 sensors with a laser line width of 19 µm ensure precise and fast data acquisition as well as easy integration into any system thanks to its standard GenICam interface.

The Reason for the Welding Inspection of EV Batteries

Welds play a crucial role in the production of these vehicle batteries in many ways, as they contribute significantly to the structural integrity, safety and reliability of the battery packs. The battery cells in an EV battery pack must be firmly and securely connected to each other to withstand vibrations, shocks and other mechanical stresses that occur during vehicle use. Welded seams therefore ensure that the cells are securely fastened in the housing and prevent them from coming loose or shifting. They also protect the battery from external influences such as moisture, dust and other contaminants, so that no corrosion or short circuits occur. Another aspect is the electrical connection of the individual cells in the EV batteries. The weld seams must also be robust and reliable at this point in order to ensure a stable power supply and prevent overheating or electrical failures. And finally, the consistency of the weld seams is of course also crucial in the mass production of EV batteries. Automated welding processes that are precisely monitored and tested help to minimize production errors and ensure the safety of the batteries.

„We have been working with AT since 2017 and are particularly familiar with the quality of their 3D sensors and their good feel for our customers' requirements. The C6 compact sensors used at GES fulfill exactly the requirements that the customer placed on the sensor for their inspection system thanks to their high resolution and profile speed. We were able to score points directly with GES so that they didn't need much time to make their decision," reports Jason Chung, Marketing Assistant at Fainstec.

Application with a Future

Welding Inspection with the AT sensors is now a common procedure that GES successfully uses with numerous end customers who test EV batteries. Thanks to this application, both the product quality of the batteries and operational safety have been significantly improved in various production lines. This application is successfully used in Korea and shows how crucial advanced sensor technology is for the future of e-mobility. ■

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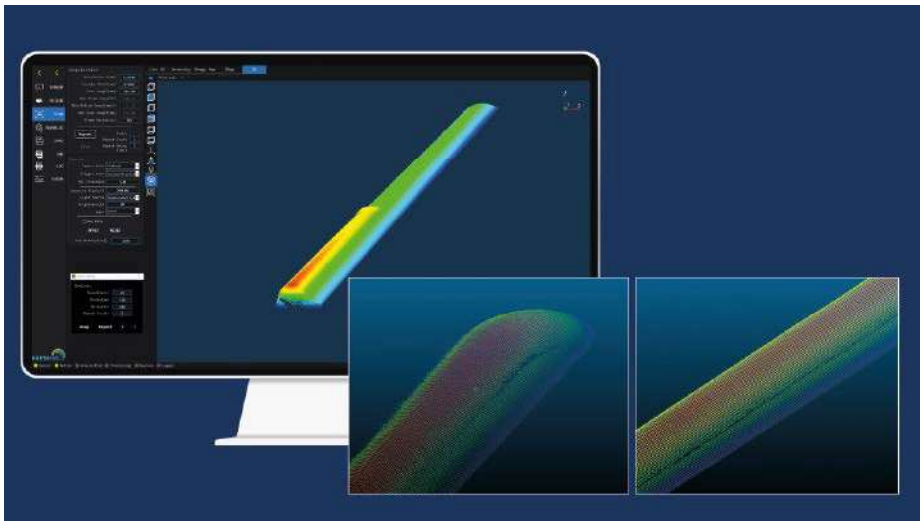

The 3D scan of the weld seam of a prismatic battery recorded with the Fainstec "Clip Studio" visualization software

The C6 1280 sensors with a laser line thickness of 19 µm ensure precise and fast data acquisition as well as easy integration into any system thanks to its standard GenICam interface.

“Without 3D visual inspection, high-power batteries would not be possible to produce”

Interview with Dr. Athinodoros Klipfel, Head of Sales at Automation Technology

Automation Technology, a manufacturer of 3D and infrared components, is to offer not only high-precision but also extremely fast 3D sensor technology in the field of battery inspection. We spoke to Head of Sales Dr. Athinodoros Klipfel about how AT has still managed to maintain its monopoly position in this sector and why there would be no electric cars without 3D sensor technology.

inspect: What are common features that are inspected using (3D) machine vision in battery production today?

Dr. Athinodoros Klipfel: The battery production process involves several critical steps where 3D machine vision plays a key role in ensuring product quality and reliability:

1. Cell Production: During cell production, one of the most important inspection points is the electrode foil. Here, 3D machine vision systems measure the thickness of the foil and detect burrs on the foil edge after the slitting process. Ensuring precise foil dimensions and defect-free edges is crucial for consistent battery performance.

2. Cell Finishing and Quality Control: Once the cells are produced, they undergo thorough quality checks. For cylindrical cells, surface inspection detects imperfections, while prismatic cells require isolating coating inspection. For pouch cells, 3D inspection ensures that surface integrity is maintained, preventing issues that could lead to swelling, leakage, or electrical failure.

3. Welding Inspection: High-precision weld quality inspection is critical, especially for busbars and tab connections, where defects can lead to electrical resistance issues.

4. Module Assembly: As multiple cells are grouped into modules, 3D vision systems verify that cells are correctly positioned and aligned before final pack integration.

Let me give you three specific examples of recent projects in this space where our 3D sensors have been a core part of the solution:

One of our integrators and long term solution partners was challenged with a project to develop surface inspection of cylindrical battery cells for EVs. Other customers of ours developed inspection systems checking the welding on prismatic batteries cover (cap-can application), while others dealt with the inspection of isolating coating.

inspect: How did AT got involved its 3D sensor technology in this very special industry?

Klipfel: Our 3D sensors are famous in the industry for their high profile speed, high resolution and their advanced laser triangulation functionality. AT got involved in this very special industry as battery manufacturers sought high-performance 3D inspection solutions for their production. System integrators and OEMs developing inspection systems had the need to use AT sensors in order to fulfill the requirements of those applications.

inspect: Why should customers choose AT instead of products from the competition?

Klipfel: The 3D sensors of AT feature an unprecedented combination of high profile speed and high resolution enabling the development of fast and precise inspection systems. Thanks to their modularity they can be adapted and optimized to perfectly meet the requirements of any application. System integrators and OEMs can be benefited from the use of AT sensors by maximizing the performance of their inspection systems and by shortening their time to market.

inspect: How did you manage it to develop a 3D sensor which generates high density scans?

Klipfel: We have developed our own laser triangulation imager with 3K resolution and on-sensor processing, which allows capturing 3D profile data at a galactic speed of up to 140 kHz. The technology is called Widely Advanced Rapid Profiling (WARP) and it is unique in its kind. WARP enables the generation of high density 3D scans for use in a broad range of inspection applications.

inspect: What role does 3D visual inspection play in battery production?
Klipfel: Without 3D visual inspection, high-power batteries as we know them today would not be possible to produce. Without 3D inspection, manufacturers run the risk that critical defects, such as misaligned components, poor weld quality, coating irregularities, or microscopic burrs on electrode edges, go undetected, leading to reduced performance, safety hazards like short circuits, and ultimately, costly recalls or even catastrophic battery failures in the field.

inspect: And vice versa: What role does electromobility currently play as an application for AT sensors?
Klipfel: Electromobility currently plays a major role for the AT sensors, as most 3D inspection applications require high speed laser profilers generating high density 3D scans. AT is the only brand in the market offering 3D sensors that fulfill those requirements.

inspect: In Europe at least, the recent sharp rise in growth rates for e-car sales has not been maintained. How do you think the market for 3D machine vision will develop with regard to electric car parts inspection?
Klipfel: While the growth rate for electric vehicle (EV) sales in Europe has recently leveled off, the long-term trend remains clear: the global transition from internal combustion engine (ICE) vehicles to EVs is inevitable. This shift will continue to drive the need for high-precision inspection technologies, including 3D machine vision.

Beyond batteries, many other critical electric car parts also rely on advanced inspection systems. For example, connectors, wiring harnesses, and electronic control units (ECUs) need detailed inspection, often with 2D, thermal, or hyperspectral vision. Structural components like aluminum housings for electric motors and inverters also require dimensional and surface checks to ensure proper fit and performance. The demand for 3D inspection is particularly strong in areas like battery production and assembly, but comprehensive quality control across all these parts is essential to ensure reliable and safe EVs.

Even though the growth rate has slowed in the short term, we expect continued investment in EV production technologies as the automotive industry pushes toward electrification. This shift involves not just expanding production capacity, but also upgrading existing manufacturing lines and introducing new designs. As battery technology evolves – moving towards solid-state batteries, for instance – the complexity and precision required in manufacturing will only increase, driving sustained demand for advanced inspection solutions. ■

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