

# Innovative test sensor uses artificial intelligence

## DENKweit GmbH from Halle (Saale) develops measuring equipment for non-destructive tests of battery modules.

Battery systems for electric cars have to meet high standards of quality, but until now non-destructive testing of the batteries has not been possible. The start-up DENKweit from Halle (Saale), a spin-off from the Fraunhofer-Gesellschaft, has developed innovative test sensors and linked them to an artificial intelligence system. This allows every individual cell of a battery to be monitored both during the production process and later when in use in the car.

The battery cells for electric cars are often referred to as pouches, bags or even coffee bags. And each of the cells, which are around 10 by 15 centimeters in size, is actually very similar to a plastic bag or a drink pouch. But it's not a good idea to open the pouch cell, as Dominik Lausch and Kai Kaufmann explain with a smile in their videos on the web. Then they demonstrate what happens if you do. The lithium in the cells is highly reactive and flammable. "The airtight seal on the cell prevents the materials from going up in flames," says Kai Kaufmann. An uneven swelling can be felt on the pack in his hand. Irregularities of this sort can be caused by deposits or short circuits, he explains and puts the cell under the sensor of the test device developed by his company DENKweit. The young company from Halle (Saale) has made a name for itself, because "Made in Germany" has a good reputation on the global market. DENKweit GmbH is selling its innovative measuring device to research laboratories throughout the world where batteries for electric cars are developed and improved.

### Non-destructive quality control

Depending on their power output, battery systems for electric cars consists of thousands of lithium-ion packs connected in series. "If there is a fault with only one of them, this could lead to the whole battery failing or, in the worst case, the car catching fire. Of course manufacturers want to avoid that happening at all costs," says Dominik Lausch, highlighting the unique selling point of the new technology developed by DENKweit. For the first time, it allows the strength and direction of electric currents to be measured over large areas in real time using a non-contact method. Physicists have known about the principle behind this for over 200 years. "When a current flows through a conductor, a magnetic field is generated. If a component is faulty, the strength or direction of the current changes and so does the magnetic field," explains Lausch. However, until now it has not been possible to identify defects in batteries using non-destructive methods and therefore they could only be found by random testing.

### Bridging the gap between photovoltaics and electric cars

Two-and-a-half years ago, the researchers Dominik Lausch, Kai Kaufmann and Markus Patzold from the Fraunhofer Center for Silicon Photovoltaics CSP in Halle (Saale) founded their start-up and called it DENKweit (literally "think far" in German). When they established the company, the idea of the three men, who all have doctorates in physics and specialize in the field of photovoltaics, was to think far into the future. They developed an in-line system for use on production lines that automatically identifies defective solar modules. Their second piece of equipment, a hand-held device, allows solar modules to be monitored in operation and faults to be identified at an early stage. In 2019, DENKweit was presented with the IQ Innovation Award for Halle and for Central Germany for its two inventions. The second prize was funded by the Volkswagen Group, among other companies, which gave the three entrepreneurs the idea of opening up a new market in the automotive industry. The innovators from Halle (Saale) traveled to Salzgitter, where VW manufactures the battery cells for its latest electric cars, and impressed the engineers there with a possible use for their invention. The new line sensor measures the magnetic field not only at individual points, but also over large areas, in real time and using a non-contact method. This makes it ideal for identifying defects and carrying out quality checks on electric car batteries. In addition, the team from DENKweit have linked their state-of-the-art sensor with machine-learning algorithms. The self-learning software automatically recognizes the defect in the cell or the weld seam and converts the measurement results into images. Dominik Lausch and his team supply their detection program with data from defective battery systems and fault simulations. As Lausch explains: "The neural networks of artificial intelligence systems generally have to be supplied with hundreds of items of data. Our program only needs around 30 images and it can generate many new ones from them."

### Opportunities on the global market

Experts in the field have been amazed by this. Last year the young company was invited to join Volkswagen's incubator program. As part of the Future Mobility Incubator, DENKweit can develop its visionary ideas with technical support and expertise from Volkswagen, which will enable it to gain access to the global market. The company believes that its laboratory test device, its fully automated in-line device, which can be integrated into any stage of the battery production process, and its hand-held device, which can be used in workshops to diagnose faults, all have a genuine chance of success.

DENKweit is preparing for the mobility of the future. The three founders have built up a team of 16 employees, including hardware and software developers, programmers and AI experts. In preparation for the challenges that it is likely to encounter on the market, the company is wisely already looking for new members to join its team, including engineers, mathematicians and IT specialists, and it is also maintaining its contacts with the nearby universities in Halle and Magdeburg. DENKweit is planning to stay at its base in Saxony-Anhalt. "We have had a lot of interest in our start-up from public sector bodies and politicians on a local and a state level. We know how important that is for us," says CEO Dominik Lausch. He explains that personal communication and rapid decision-making are very valuable, particularly during a company's early days and its growth phase. Kai Kaufmann reinforces this: "We attract attention here in Saxony-Anhalt and people listen to what we have to say."

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