**Technical report**

**June 2024**

**Velvet gloves for batteries**

They are smeared, rolled and cut - the journey that copper and aluminium foils have to go through before they can perform their role as anode and cathode in a battery sounds tough. Handling between the individual production steps must be all the gentler - how does this work?

The government has been promoting electromobility since 2009. The development and production of battery technology is also being promoted: Industry and politics are working to establish and expand the know-how for development and production. The fact that economical battery cell production is possible in Germany was confirmed by Dr. Michael Meister, Parliamentary State Secretary to the Federal Minister of Education and Research, 2021 at the "Battery Forum Germany". Reports from German car manufacturers about cooperations, their own research laboratories and test plants for series production confirm this. In addition to their use in e-cars, batteries are just as important for everyday life. From cordless screwdrivers to e-bikes and smartphones - it is impossible to imagine life without electricity "to go". Equally relevant is the stationary application, for example to buffer regeneratively generated energy.

Every application places its own demands on battery technology. But for the production, the subsequent use is secondary - because here, in every case, the greatest care and precision must be reconciled with competitive cell production. The little helpers that enable gentle transport of the sensitive cathodes, anodes, separators and pouch cells are irreplaceable: special grippers and end effectors from J. Schmalz GmbH.

**From powder to pouch**

Two pastes and two metal foils form the basis of each drive battery. For the anode, a graphite paste is spread on a copper foil. The cathode consists of an aluminium foil onto which a metal oxide mixture of nickel, cobalt, manganese and lithium is applied. The foils, coated on both sides, are dried, calendered and cut to size. Now they are ready for stacking. "We recommend the special grippers STGG for this, as they can handle the sensitive foils highly dynamically," explains Dr. Maik Fiedler, head of the Vacuum Automation and Vacuum Handling business units. The STGG alternately grips the anode, separator, cathode and separator again in order to deposit them on top of each other. The focus here is on speed as well as precise positioning. In the process, the gripper must not leave any marks or contaminate the sensitive coating. "Our solution is called PEEK," says Dr. Fiedler. Schmalz uses the chemically highly resistant polyetheretherketone to manufacture a suction plate with many small holes that grip over the entire surface. The flat surface minimizes the surface pressure. The active blow-off function of the STGG accelerates the pick & place process, while the high volume flow prevents particle residues on the electrodes. Pneumatic vacuum generation without moving parts makes the special gripper suitable for clean and dry rooms.

The special gripper STGG is also suitable for separating and depositing thin separator films. Separators usually consist of very fine-pored flexible plastics or nonwovens. They spatially separate the anode and cathode from each other and prevent a short circuit. At the same time, they are permeable to the positive lithium ions that flow from the anode to the cathode during discharging and migrate back again during charging. "The STGG works with a high volume flow and thus also safely grips porous materials," explains Dr. Fiedler. The ESD-compliant surface also reliably dissipates electrostatic charge and thus protects against unwanted adhesion.

**Cell by Cell**

Once the cell stack is ready, the protruding conductor flags are shortened and the stack is packed into a pouch foil. Sealed all around, the so-called pouch cell is ready for the electrolyte injection. "The pouch cells are sensitive and must not be deformed by the gripper under any circumstances. In addition, they can vary in shape depending on the application," explains Dr. Fiedler. The lightweight gripper SLG is suitable for any geometry. Schmalz manufactures it additively after the customer has configured it online, thus guaranteeing short delivery times. Structured suction cups from the SFF or SFB1 series are used so that the aluminum composite film of the pouch cell is not deep-drawn during gripping. Both variants combine support surfaces in the form of honeycombs on the suction surface with a soft and particularly flat sealing lip. This allows them to grip gently yet with a high suction force without deforming the surface of the pouch cell.

Just as important as the material, geometry and size of the gripper is the vacuum. How and where it is generated is the key to highly dynamic and at the same time absolutely safe handling. "Our decentralized vacuum generators of the SCPM series meet all these requirements. They are compact and at the same time have high suction power," says Dr. Fiedler. They are so small that they can be mounted close to the suction pad, thus minimizing power losses. The valve of the compact ejector closes when no current is applied. This allows the gripper to hold the battery cell securely, even if the power fails. "Another advantage is that users can integrate special functions into the system, such as redundant vacuum generation or workpiece detection," adds Dr. Fiedler.

The appropriate handling system places the individual cells in a module, where they are connected in series or parallel. Several modules result in a battery pack that combines fewer or more pouch cells, depending on the manufacturer and vehicle category.

**Round instead of flat**

The advantage of pouch cells is that they have a flat design and can therefore dissipate heat well. They are versatile and make optimum use of the available volume in a battery module. Their disadvantage is that the casing is sensitive and does not protect the anodes, cathodes and separators from mechanical influences. In addition, there is a risk that they will inflate, for example as a result of aging processes. Cylindrical hard-case cells are therefore often used in some electric cars as well as in consumer electronics, e-bikes and tools. "For handling round cells in module assembly, we need to offer users grippers that they can configure freely. Depending on how large the individual cells are in diameter, in which arrangement and how many are to be gripped," describes Dr. Maik Fiedler. "Thanks to 3D printing, this is easily possible from batch size one." If the user chooses suction cups made of the low-imprint special material HT1, he can grip the cells directly at the pole - the material also acts as an insulator. In this way, even charged cells are positioned safely. A high volume flow is also important here for the fast and clean pick & place process. "This is where integrated vacuum generators score. The ejectors have a safety valve that maintains the vacuum even without power, thus safeguarding handling," adds Dr. Fiedler. If the round cells have to be gripped lengthwise, Schmalz recommends magnetic grippers SGM in the high-performance version. Here, a permanent magnet secures the handling. "They are compact, lightweight and yet develop high holding forces," Dr. Fiedler lists the advantages. These are effective as long as the battery casing is ferromagnetic.

**Finale - fully automatic or manual**

Now it's almost done: Foils have become cells. The cells have been combined into modules, which are now connected in battery packs and completed with cooling plates, wiring and electronics. "Flexibility is enormously important here. The storage geometries can differ just as much as surface structures," explains Dr. Maik Fiedler. Even if the modules are heavy, they must not be damaged by the gripper - vacuum manages this. The large-area gripper FQE is modular and ideally suited for fully automated pick & place applications. The large-area gripper FMP is just as universal. Its sealing foam also adapts to structured surfaces. With their energy-efficient, integrated vacuum generation, both ensure low operating costs.

In the work steps that are not automated, manual lifting aids such as the vacuum lifter JumboFlex relieve the assemblers. These can be the cooling modules or the cover plates, which have to be placed manually on the battery housings at the end. Extra safety is provided by the Safety+ operating unit: The two-hand release concept protects particularly sensitive workpieces during placement. In addition, the lowering speed can be reduced.

The battery pack is now ready for the leak test - the housing and cooling system must not show any leakage. The battery management system receives the latest software, suitable for the car type, and the first charge/discharge process in the network takes place under strict supervision. If the wiring and electronics are in order and the battery management system works as well as all subcomponents, it is done. After labelling with warnings and ID tags, the batteries are ready for transport. "It's a long and complex journey from powder to finished energy storage device. We know how to handle each individual process step safely and develop custom-fit solutions for our customers," says Dr. Maik Fiedler.

(9,238characters including spaces)

**Meta-Title:** Soft access in the production of Li-ion batteries

**Meta-Description:** Fully automated handling is also part of economical battery cell production. The gripper solutions from Schmalz are safe and at the same time gentle on the sensitive flexible anodes, cathodes and pouch cells.

**Keywords:** Schmalz; battery cell production; special gripper STGG; suction plate; special gripper; battery module; pouch cell; pick & place process; magnetic gripper SGM; JumboFlex; Safety+; SLG; SFF; SFB1;

**Images:**

|  |  |
| --- | --- |
|  | **Image 1:**  The special gripper STGG grips and places the anode without contaminating the sensitive graphite layer. |
|  | **Image 2:**  High suction force with low vacuum: The special gripper STGG is also used for handling extremely thin separator films. |
|  | **Figure 3:**  The lightweight gripper SLG with SFF suction pads handles pouch cells. The structured suction pads prevent deep drawing of the housing foils. |
|  | **Figure 4:**  Cylindrical Li-ion batteries are mainly used in consumer electronics and e-bikes. Schmalz develops individual end effectors - depending on the number, size and arrangement. |
|  | **Figure 5:**  The large-area gripper FQE with energy-efficient, integrated vacuum generation is used for handling housing parts of battery cells and battery modules. |
|  | **Figure 6:**  Dr. Maik Fiedler, Head of the Vacuum Automation at J. Schmalz GmbH |

Pictures: J. Schmalz GmbH

**About the company**

Schmalz is one of the market leaders in automation with vacuum and for ergonomic handling systems. The products of this international company are used in logistics applications as well as in the automotive industry, the electronics sector and furniture production. The wide range of products in the Vacuum Automation business segment includes individual components such as suction pads or vacuum generators, complete gripping systems and clamping solutions for holding workpieces, for example on CNC machining centers. In the Handling business segment, Schmalz offers innovative handling solutions for industry and trade with vacuum lifters and crane systems. With the Energy Storage business unit, the company is building up another mainstay in the area of stationary energy storage systems.

The combination of comprehensive consulting, a high focus on innovation and first-class quality ensures sustainable added value for customers. Intelligent solutions from Schmalz make production and logistics processes more flexible and efficient - and at the same time fit for the advancing digitalization.

#### Schmalz is represented in all important markets with its own locations and trading partners in around 70 countries. The family-owned company employs around 1,800 people at its German headquarters (Glatten, Black Forest) and in 28 other companies worldwide.

#### Contact for questions

J. Schmalz GmbH

Marketing communication

Johannes-Schmalz-Str. 1

72293 Glatten, Germany

T: +49 7443 2403-506

[presse@schmalz.de](mailto:presse@schmalz.de)

[www.schmalz.com](http://www.schmalz.com/)

**You can find further press releases on our website**

<https://www.schmalz.com/de/unternehmen/schmalz-aktuell/presse/>

**Reprint free of charge - voucher copy requested**