Multifunctional adhesive tapes for EV batteries and electric vehicles

Against the background of the global objective of reducing carbon emissions and achieving the targets of the United Nations Paris Agreement, companies in almost every industry are focusing on developing more sustainable products and solutions. In the automotive industry, the emphasis is on electric vehicles and the production of batteries and energy storage systems, as the European Union and countries in other parts of the world are planning to phase out the production of combustion engines from 2035.

The battery industry has a dual impact on sustainability. On the one hand, there is an increasing focus on reducing CO_2 emissions from the production of EV batteries, in relation to both the materials used and the manufacturing processes. On the other hand, the end products themselves contribute to the achievement of global sustainability goals. A calculation produced by the European NGO Transport & Environment (T&E) shows that electrically powered vehicles cut CO_2 emissions by 37 percent, even in the worst-case scenario, depending on the power source used for production and the length of the supply chain, among other factors. Under ideal conditions, emissions can be reduced by up to 83 percent [1].

Developments in the battery sector are progressing rapidly. Battery manufacturers are constantly working on identifying alternatives to conventional steel and aluminum housings with the aim of saving weight and improving the battery performance, range and fast charging as well as energy density, cycle life and low-temperature battery performance. The aim is to get the maximum performance out of a battery safely. This also requires reliable electrical systems, including effective protection measures against electromagnetic waves to avoid interference and intelligent grounding solutions to prevent short circuits. Weight savings can also be achieved in the electrical systems, for example by dispensing with some cables.

To support these trends in the field of electric vehicle batteries and the increasing digitalization and miniaturization of systems, Lohmann supplies tailor-made adhesive solutions and high-precision diecuts (*Figure 1*). The range of multifunctional materials includes adhesive tape solutions that provide functions such as damping, sealing, electrical insulation and conductivity as well as efficient thermal management. These adhesive tapes play a crucial role in improving battery performance, extending battery life and ensuring that production processes are reliable and efficient. Lohmann focuses on developing an increasingly sustainable value chain that covers all the stages of production from adhesive manufacturing to in-house conversion. For example, the company's production processes uses only green electricity, the supply chain is as short as possible and located in Europe, and, depending on the customers' requirements, ranges of solvent-free adhesive tapes can be produced. In addition, Lohmann already calculates the complete

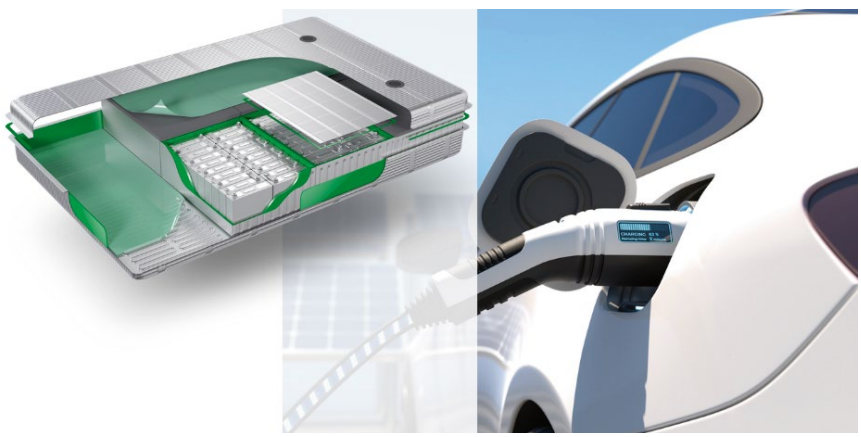

Figure 1 Multifunctional adhesive tapes are ideal for use in EV batteries.

in-house PCF (product carbon footprint) of its products from cradle to gate, taking into account all the upstream processes, the resource extraction and the production up to the moment when the product leaves the factory. This helps the company's partners to calculate and optimize the individual carbon footprint of their own end products.

Optimizing battery performance: thermal management

EV batteries are becoming increasingly compact with the aim of saving weight. In addition, more cells with a higher energy density are being combined to improve performance. This results in the generation of more heat in the module or pack. To ensure that this heat is transferred safely and reliably within the EV battery, the Duplo COLL TC (thermally conductive) range of acrylic transfer tapes has been developed (*Figure 2*).

The TC adhesive tapes offer a thermal conductivity of up to 2 W/mK and are tested in accordance with ASTM D 5470. These tapes are used to connect the cooling plate to the battery module and help to keep the temperature of the lithium-ion cells between 20 and 35 °C. They ensure optimum battery performance as a result of the homogeneous transfer of the heat. In addition, because of their good adhesion to a variety of substrates, they offer reliable protection against corrosion, which contributes to the reliable, trouble-free functioning of the battery throughout its lifetime.

The thermally conductive adhesive tapes are tested in accordance with UL94 and have the V0 classification. They also provide excellent electrical insulation for the components that they are applied to. Depending on the electrical insulation requirements, they can make other measures such as the application of coatings or electrical insulation films superfluous. The tapes contain no silicones, halogens or solvents. The pressure-sensitive adhesive tapes can easily be applied to irregular surfaces and produce excellent surface wetting. Unlike liquid thermal interface materials (TIMs), there is no squeeze-out when assembling components with adhesive tapes. The PSA (pressure-sensitive adhesive) tapes do not require any special storage conditions, such as cold rooms, and they can be applied using conventional machines for adhesive tapes. As

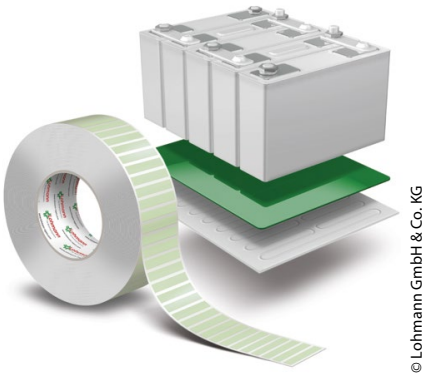

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Figure 2 Thermally conductive adhesive tapes provide an efficient and reliable connection to the cooling or heating element.

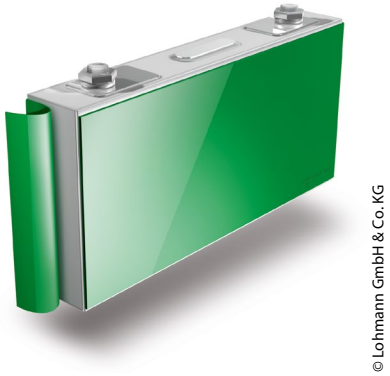

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Figure 3 Single or double-sided adhesive PET films are ideal for the electrical insulation of sensitive battery components and provide effective protection against short circuits.

these tapes are customized to meet individual customers' requirements, they allow a high level of design freedom. They also have the advantage over silicone gap fillers of avoiding the risk of silicone oil migrating. Furthermore, they have good initial adhesion at room temperature and therefore do not need any additional fixing during the assembly process. By dispensing with the requirement for screws or staples, the adhesive tape solutions represent a flexible, weight-saving alternative that combines fixing and function in one product.

Optimizing battery performance: electrical management

Electrically conductive, single-sided adhesive foams and tapes ensure that electronic devices function without problems throughout their entire service life (*Figure 3*). The Duplo COLL EC (electrically conductive) adhesive tapes also have a metallized fabric or foam backing and an electrically conductive acrylic adhesive on one or both sides, together with a 50-µm transfer tape with an electrically conductive acrylic adhesive. These adhesive solutions are used for electrical connections with low currents, connecting conductive materials, EMI shielding and grounding. This eliminates the cost of additional connecting wires. The fabric adhesive tapes are available in isotropically and anisotropically conductive variants, while the foam adhesive tapes are isotropically conductive and tested in accordance with ASTM D 4935. The EC tapes with grounding and shielding properties against electromagnetic waves are ideal for use in electronic components. The combination of an electrically conductive backing material and an electrically conductive adhesive provides excellent shielding in the range from 450 MHz to 3.8 GHz (5G). This allows electronic components that are operated in close proximity to each other to be used safely. The electrically conductive foam tapes can easily be compressed and therefore compensate for the tolerances between components. At the same time, they provide a permanent grounding function with continuous contact.

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Figure 4 The tapes include electrically conductive solutions with metallized fabric or foam backings and electrically conductive acrylic adhesive and electrical insulation solutions, such as single-sided adhesive PET films in various thicknesses and colors.

Figure 5 Coated materials are processed in-house to produce rolls, spools and sheets of many different sizes.

Safe connections throughout the service life of the battery

The safety and longevity of lithium-ion batteries are of crucial importance in the development and operation of electric vehicles. In this context, the DuploCOLL IS (insulating) functional tapes play a key role, as they provide electrical insulation for metal components to prevent short circuits and, in combination with a foam, offer damping and sealing properties that protect sensitive components such as flexible circuit boards and busbars (*Figure 4*). These damping properties help to minimize the potential risks associated with loose connections or structural failure, which in turn ensures the safety of the vehicle and its occupants.

The polyimide versions of these adhesive tapes are particularly suitable for applications where high heat resistance is required in combination with electrical insulation. Single- and double-sided PET films for high-voltage insulation with a high dielectric strength are available. The various different tapes help to ensure that the battery modules in electric vehicles operate safely, reliably and efficiently throughout the entire service life of the battery.

Efficient, safe production processes

The mass production of EV batteries requires efficient and safe manufacturing processes. Multifunctional adhesive tapes simplify the assembly of battery modules as a result of their reliable adhesion and ease of use. The tapes allow the different materials used in battery construction, including metals, plastics and composites, to be joined together,. This shortens production times, resulting in cost savings for electric vehicle manufacturers.

In addition, functional adhesive tapes are space-saving solutions that can improve the design of battery modules and therefore make the development of lightweight, compact battery packs easier. The thin, flexible tapes are also available as high-precision die-cuts. Unlike liquid adhesives, they require no additional processing tools or special storage facilities. Because of their customizable format, they offer a high level of design freedom. Concepts such as the "segmented frame" allow for sustainable die-cutting with minimal waste.

Customers receive support with the manual, semi-automatic or fully automatic integration of adhesive solutions into their production processes, including pick-and-place operations. In the case of fully automated processes, tapes in different colors are available for better camera detection. These colored insulation tapes improve the reliability of the application process. The entire value chain comes from a single source which eliminates the need for long supply chains and reduces dependence on external partners (*Figure 6*).

Conclusion

Manufacturers of electric vehicles can make their production processes more efficient, increase productivity and, at the same time, ensure the safety and quality of their battery modules with the use of adhesive tapes. Multifunctional adhesive tapes are a key component in the development and operation of batteries for electric vehicles. With solvent-free, low-emission adhesive systems and tapes, it is possible to improve the performance, safety, reliability and service life of batteries. //

References

[1] Statzon, Electrifying the Future: A Comprehensive Handbook on the EV Market, 2023, p. 5

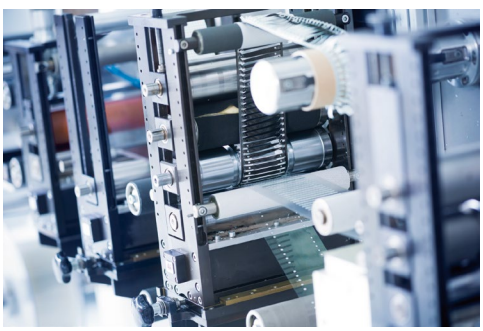

Figure 6 The adhesive tapes are manufactured in-house with no intercontinental supply chains. The high-precision manufacturing processes include laser plotting and rotary die-cutting.

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