Capacitec®

SLOT DIE COATER GAP SENSOR SYSTEMS

The Benefits of Using Portable Gap Measuring Devices to Maintain a Consistent Slot Die Gap Process Coating EV Battery Components

In the production of electric vehicle (EV) battery components, particularly during the application of functional coatings, maintaining a consistent Slot Die Gap and Coating Head Height is crucial to ensuring uniform coating thickness and quality. EV Battery performance consistency depends significantly on the uniformity of electrode layers produced using these coating techniques. Battery electrodes require precise uniform thickness to optimize electrochemical reactions which ensures consistent ion diffusion rates.

Variations in these gaps can lead to defects in the final product, reducing performance, reliability, and MTTF of the battery. Uniformity in coating thickness is essential for meeting regulatory standards for safety, durability, and cycle-life performance criteria.

Capacitec would like to illustrate the benefits of using portable gap measuring devices for precise calibration of slot die gaps in the coating process.

Introduction

Slot Die coating is a widely used technique for applying thin, uniform layers of material to a variety of substrates, including those used in the production of EV batteries. Effective Slot Die coating relies on the precise control of the two distinct gaps in the process. The first, a Slot Die Gap, is the gap between the two halves of the Slot Die Head. This forms the path used to deliver the Slurry to the substrate. The Slot Die Gap must be uniform across the entire width of the production web for optimal product yield. The second gap is the Coating Head Height which is the dimension between the Slot Die Head and the Substrate or reference surface. Both Gaps directly impact coating uniformity, material consumption, and the overall quality of the finished product. A small variation in either of these gaps can lead to significant defects such as uneven coating, variations in electrochemical properties, and failure to meet stringent performance standards required for EV batteries.

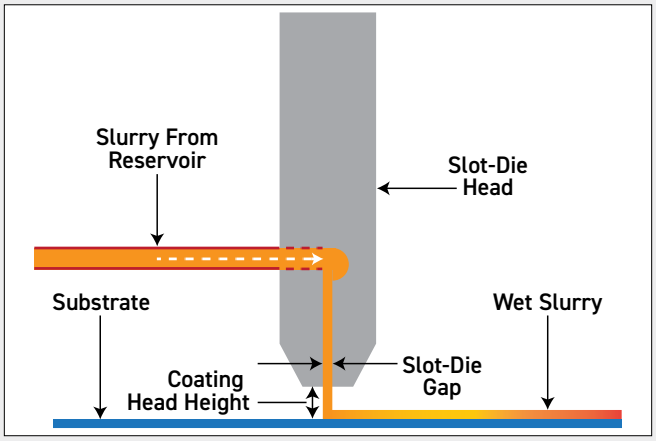


FIGURE 1. The Slot Die coating process relies on the precise control to the two distinct gaps. The first, a Slot Die Gap, is the gap between the two halves of the Slot Die Head. This separation forms the path used to deliver the Slurry to the substrate. The second gap is the Coating Head Height which is the dimension between the Slot Die Head and the Substrate.

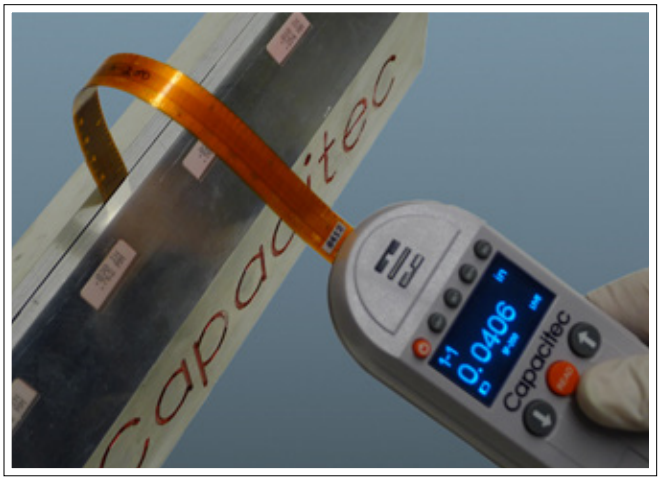
Traditional methods of coater measurements using pre-process die-half flatness checks and a feeler gauge gap and height setup, can contribute to the lack of precision demanded by quality coating manufacturers. The battery-operated Gapman, when paired with Capacitec's dual-sided capacitive sensors provides a precise gap measurement system. This solution offers significant advantages in maintaining consistency in both die gap head height across the entire web.

The Gapman is vital in the further calibration of multi slotted die heads used in Multilayer coating processes. Using the Pouiselle Flow equation: The Slurry Flow Rate is proportional to the Cube of the Slot Die gap (or channel) width. Consequently, a small variation in the gap dimension can result in significant variation in flow rates and the amount of an electrode slurry being deposited on the substrate.

Key Benefits of Portable Gap Measuring Devices

Documentation of Precise Gap Measurement

The Gapman Gen3, Portable gap measuring device enables dynamic measurement and documentation of the Slot Die gap at specified intervals across its entire width sometimes 2 meters long. This provides a direct method of recording and adjusting those very thin air gaps around the multiple load-bolt locations. This data is used for pre-production quality processes and can be transmitted and stored for postproduction quality audits. The Gapman Gen3 can store over 10,000 data points before transmitting via Bluetooth to a production system for documentation and analysis.



Improved Coating Consistency with Precision Calibration

Maintaining a consistent gap ensures uniform material deposition, which is essential for achieving the desired coating thickness and properties. A uniform gap across the entire die width leads to even coating distribution, minimizing variability in the electrochemical performance of battery components. The Gapman Gen3 supports high temperature - 250ºC, dual sided, gap sensors as thin as 0.0040 inches (102 Microns) with a resolution of 1/10,000 of an inch (0.25 Microns) or better. Manufacturers have demonstrated tighter control over the coating process using the Capacitec systems over many years. This portable Gapman solution adds ease of use to difficult locations while maintaining these very tight tolerance measurements.


Courtesy of Coating Tech Slot Dies

Key Benefits of Portable Gap Measuring Devices cont.

Portable and Flexible Measurement

One of the primary advantages of the Gapman line of portable battery-operated Gap Measurement systems is their flexibility and ease of use. These devices can be easily moved across the production line, used at different points in the process, and adapted to various die configurations. This portability is particularly advantageous for manufacturers with multiple coating stations or for those who need to perform maintenance or inspections on different parts of the production equipment. The ability to quickly verify and adjust the die gap in various locations on the line contributes to improved overall production uptime and quality assurance.

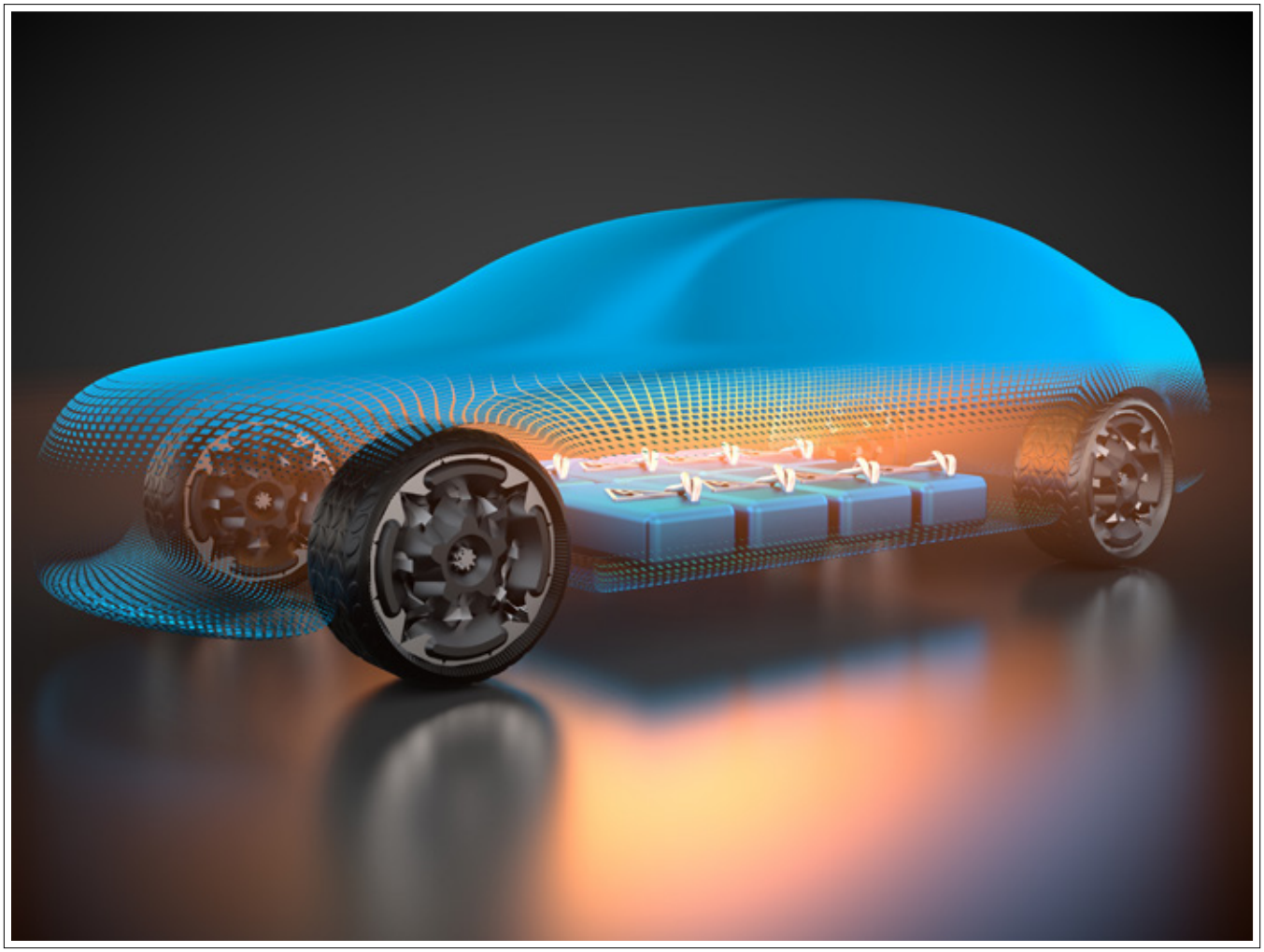
Minimized Downtime and Maintenance Costs

Preventive maintenance is crucial to ensuring that coating equipment continues to function efficiently. The Gapmen Gen3, portable gap measuring system helps identify potential issues early in preproduction. Detecting variations in the Slot Die gap in post-production, after cleaning, inspection may reveal die slot wear before major production defects result. Proactive monitoring of the gap also extends the life of the slot die and associated components by preventing excessive wear due to improper gap settings. This allows manufacturers to schedule maintenance more effectively, minimizing downtime and the associated costs of unscheduled repairs.

Conclusion

Capacitec's portable gap measuring device, the Gapman Gen4 offers significant benefits in the coating of EV battery components by providing accurate measurements of the Slot Die gap and the Coating Head Height. This enables manufacturers to maintain consistent coating thickness, reduce waste, and optimize production efficiency. The ability to consistently detect and correct gap variations leads to improved coating quality, reduced material costs, and enhanced process control. With the growing demand for high-performance EV batteries, maintaining precise control over the coating process is essential, and portable gap measuring devices play a critical role in achieving these goals.

Capacitec also offers a range of Slot Die related accessories for high temperature environments, difficult to access gaps, and precision adapters to ensure a uniform high quality coating production.



US HEADQUARTERS
Capacitec, Inc.
87 Fitchburg Road
P.O. Box 819
Ayer, Massachusetts 01432
USA
TEL: 978-772-6033
FAX: 978-772-6036
email: sales@capacitec.com

EUROPEAN HEADQUARTERS
Capacitec Europe
16, rue Séjourné
94044 CRETEIL cedex
FRANCE
TEL: 33 1 43 39 48 68
FAX: 33 1 49 80 07 49
email: eurosales@capacitec.com