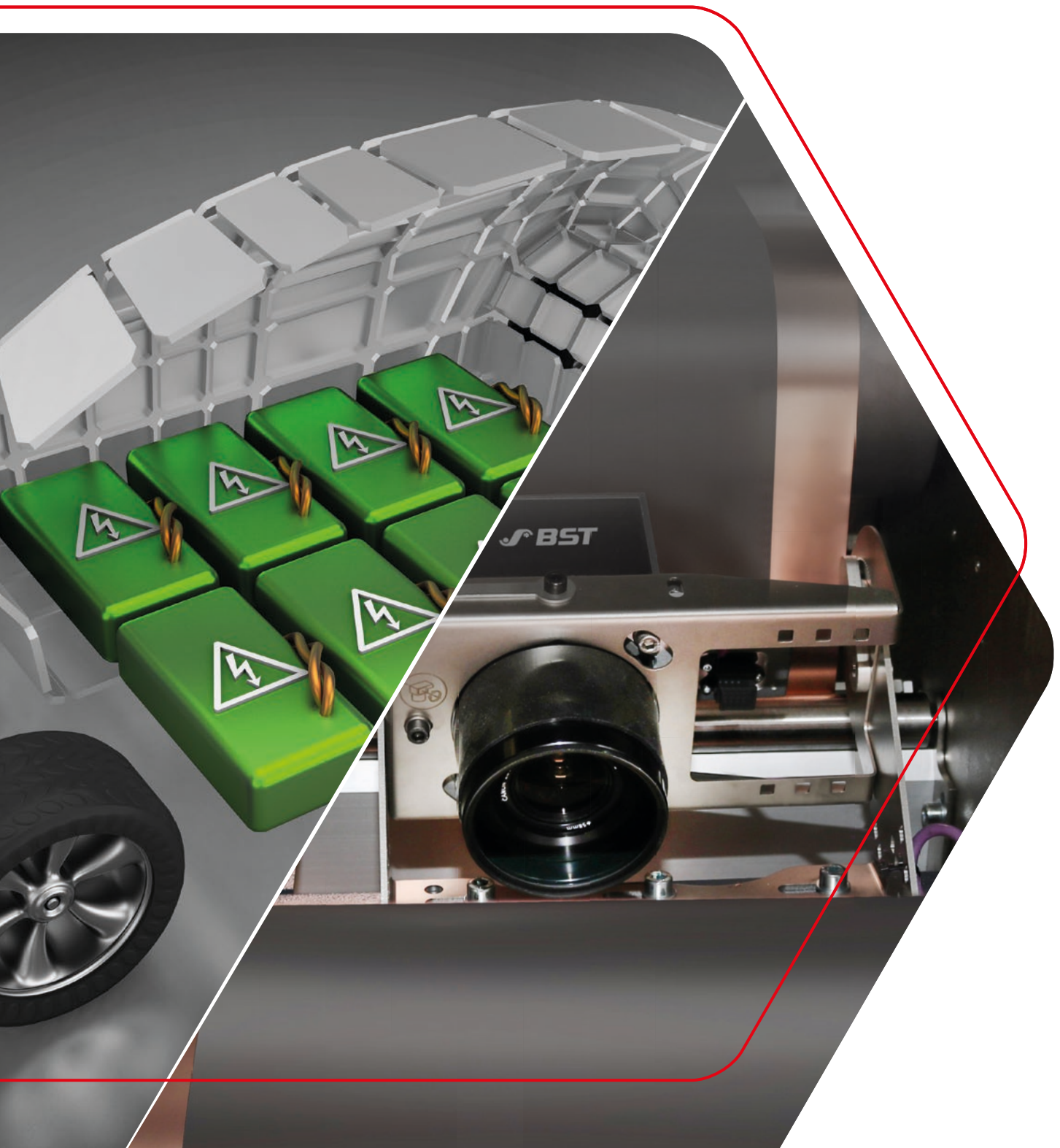
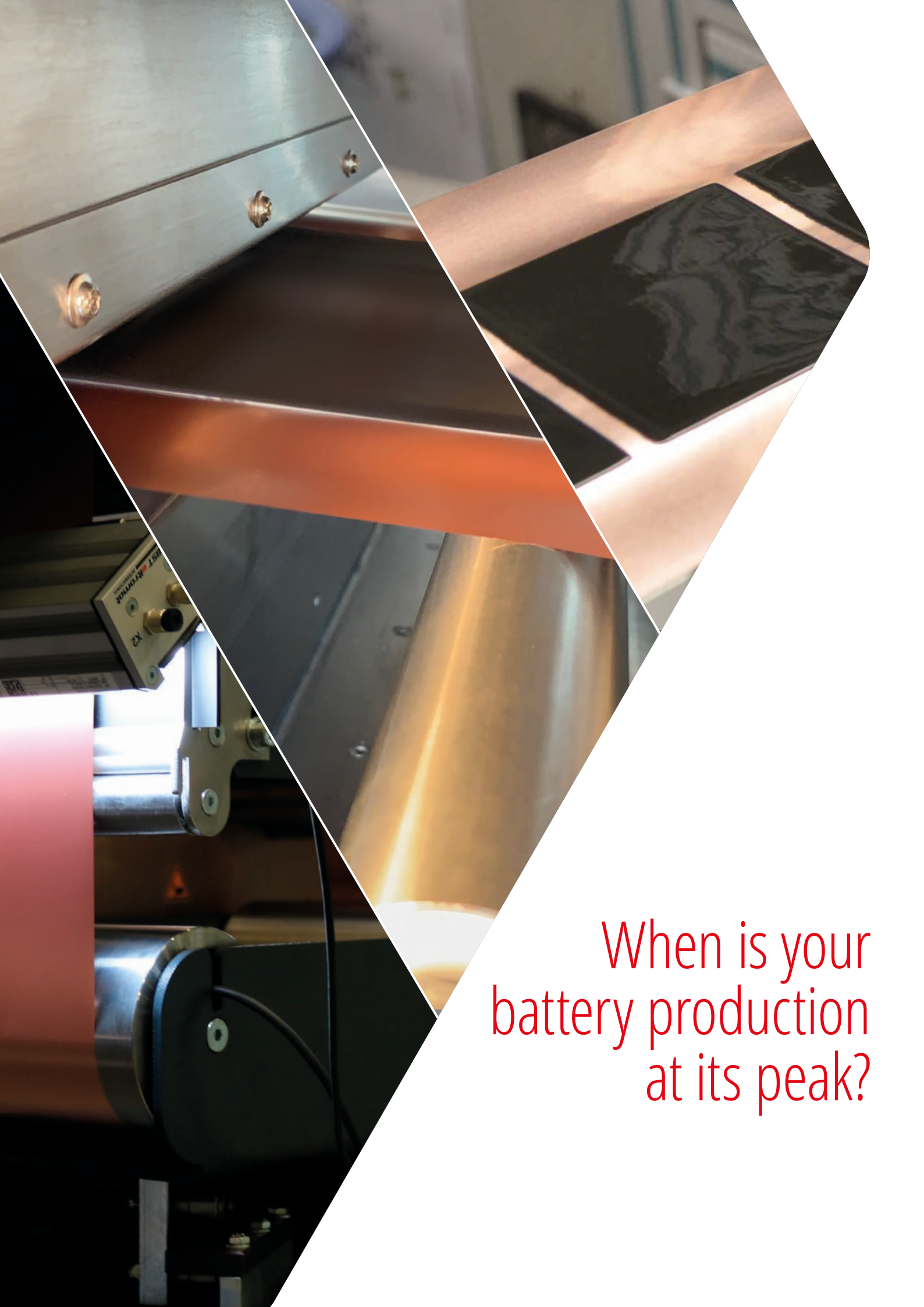


High-end surface inspection
& measurement for battery cell production

BST iPQ-Surface^{ENERGY}

100% Quality





When is your
battery production
at its peak?

When the quality is right. 100% right.

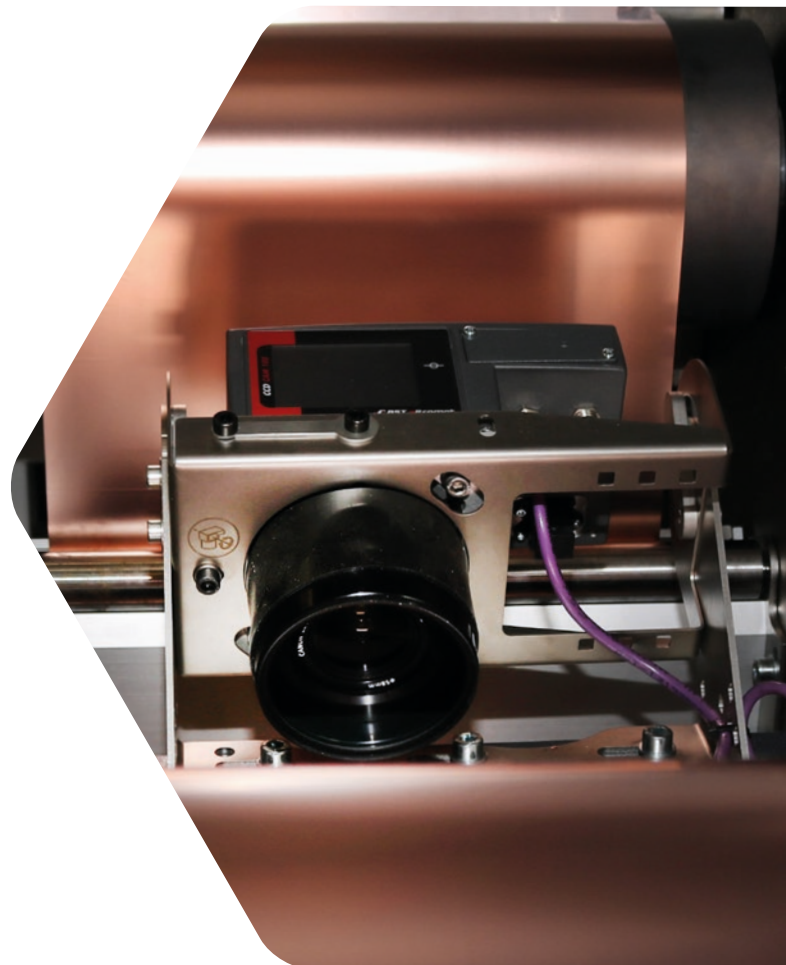
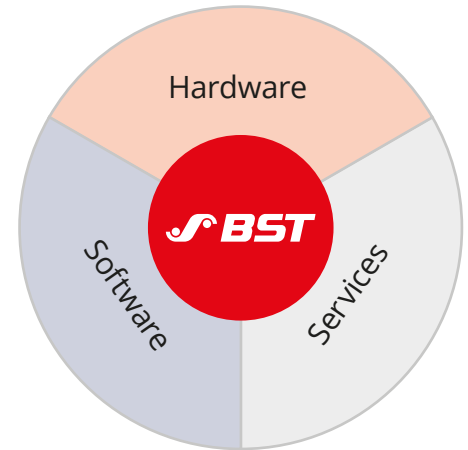
We have seen increasing worldwide demand for electrochemical storage systems for years, and there is no end in sight. This is largely due to the ever-increasing global acceptance and spread of electromobility.

Lithium-ion battery cells are the central element for these sought-after energy storage systems. Equally high demands are placed on their performance and economic efficiency, and it all starts with production. To guarantee product quality when manufacturing the electrode material in individual process steps, using an inline quality assurance system is essential to ensure the following parameters are met:

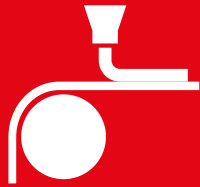
- » Stable web position control (web guiding)
- » Faultless coatings and substrates (surface inspection)
- » Compliance with web edge and coating geometry tolerances (geometric inspection)
- » Provision of valid, position-accurate quality and measurement data (track & trace)

BST iPQ-Surface^{ENERGY} supports you to master these tasks, and does so independently of the machine manufacturer. This allows you to increase the quality of your production, reduce waste and have more time for what's really important.

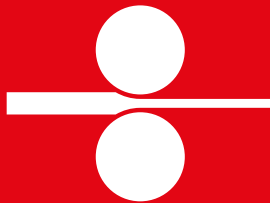
On the following pages, you will learn more about the **BST iPQ-Surface^{ENERGY}** solution in greater detail. You will discover how the hardware, software and services incorporated in the BST solution interact perfectly.



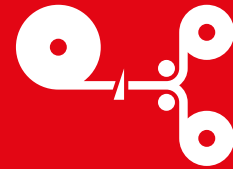
Quality assurance across processes: 100% efficient and faultless.



Coating



Calendering



Slitting

Coating

- » 100% inspection of the coating surface with an additional inspection of the carrier foils (copper and aluminum)
- » 100% inspection of coating edges for regularity, smearing and breakouts
- » 100% synchronous measurement of alignment and position of the coating from the upper to lower side

Please feel free to contact us to discuss these additional benefits:

- » Automatic alignment of the coating registers by coupling a BST web guiding system (closed loop control)
- » Precise traceability (data mapping)* of every deviation throughout the entire value chain
- » Web marking systems and controlling said systems
- » Monitoring edge elevation (heavy edges)
- » Measured value correction combined with thickness measurement

Calendering

- » 100% inspection of the surface before calendering: Detection of agglomerates and wrinkles with real-time control of calender rolls (lift-off)
- » 100% inspection of the surface after calendering: e.g. detecting chipping at the edges or within the coating, unwanted inclusions, pinholes and decontamination

Please feel free to contact us to discuss these additional benefits:

- » Reading of 1D and 2D codes (inc. DMC, QR, barcodes) for tracking purposes*
- » Precise traceability* of every deviation throughout the entire value chain

Slitting

- » 100% inspection of upper and lower side after cutting: detection of cutting dust, cutting waste, chipped coating or burr residues
- » 100% synchronous measurement of the coating and cut widths from the upper to lower side

Please feel free to contact us to discuss these additional benefits:

- » Automatic alignment of the cutting edge to the coating edge by coupling a BST web guiding system (closed loop control)
- » Precise traceability* of every deviation throughout the entire value chain
- » Web marking systems and controlling said systems

** Traceability and discharge: In cell production, it is necessary to reject electrode materials that fall below the required quality at an early stage so that the subsequent processes are not burdened. This requires positionally accurate traceability (data mapping). This helps you increase overall equipment effectiveness (OEE) while reducing total cost of ownership (TCO). Find out more on page 11.*



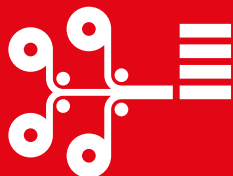
Separating

Separating

- » 100% inspection of contaminating microparticles and cutting dust on upper and lower side after punching, lasering or cutting
- » Controlling the discharge of faulty electrodes
- » Reading of 1D and 2D codes (inc. DMC, QR, barcodes) for tracking purposes*

Please feel free to contact us to discuss these additional benefits:

- » Automatic alignment of the cutting edge to the coating edge by coupling a BST web guiding system (closed loop control)
- » Automatic control of cutting tools in a longitudinal direction, e.g. rotary die cutting or laser cutter



Cell-Assembling

Cell-Assembling

- » Final inspection for defect-free surfaces and edges of the electrodes, controlling discharge signals
- » Inspection of separator foils

Please feel free to contact us to discuss these additional benefits:

- » Automatic alignment of anode, separator and cathode with BST web guiding system (closed loop control)
- » Precise traceability* of every deviation throughout the entire value chain
- » Discharge control based on the complete position-accurate quality data

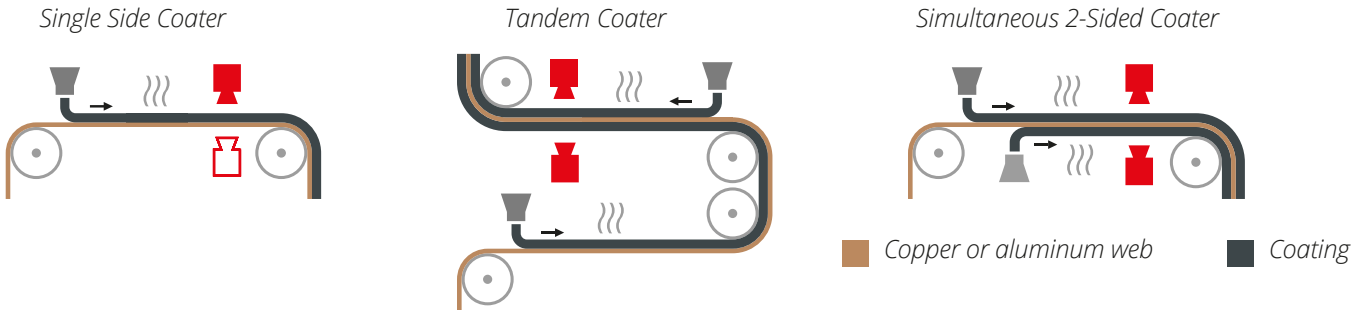


"The best thing about BST iPQ-Surface^{ENERGY} is the combined inspection and measurements tasks in a single system and user interface. This is how 100% quality is achieved in battery cell production."

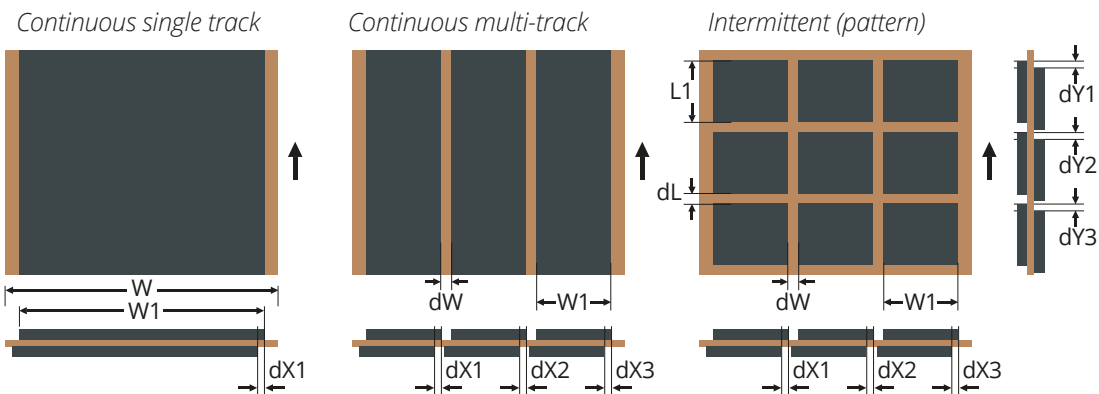
Jan Jostmeier,
Product Manager Surface Inspection



Flawless coating: 100% certainty in quality.

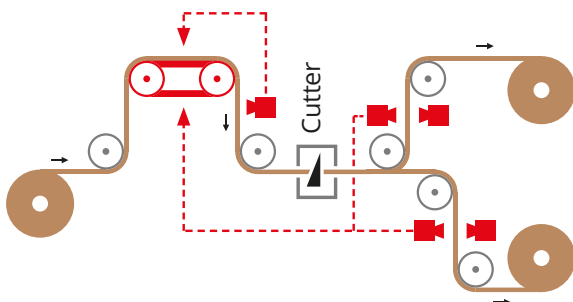


Measuring the geometric positions of front and rear sides



- » Total material width (=W)
- » Width (=W1) and length (=L1) of the coating
- » Positional deviation of front to rear side (=dX1, ...) and (=dY1, ...)
- » Distance between the coating (dW) and (dL)
- » Quality of the coating edge

Efficient slitting: 100% precision at full machine speed.



In a closed loop, quality deviations are prevented before they occur (predictive quality).



All defects in view thanks to multiplex illumination: 400% thorough – with AI support

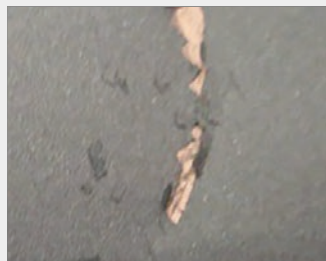
During the complex process of electrode manufacturing and cell assembly, numerous defects can occur on the webs. A surface inspection system can reliably detect and classify these defects. This allows for proactive error prevention and is crucial for safety reasons, as an example. Our

high-speed camera, combined with four simultaneous lighting scenarios (multiplex), ensures 400% that you will not miss a single thing. To ensure particularly efficient and above all scalable defect detection and classification, AI is an integral component of **BST iPQ-Surface^{ENERGY}**.

Your benefit: by partnering with the surface inspection system as a user, you can teach the system defect classes. These are then automatically assigned more and more precisely on an ongoing basis.



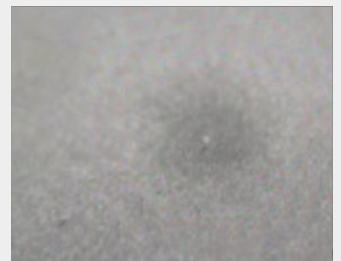
Agglomerates



Fatal damages



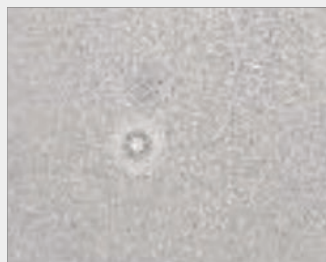
Delamination



Black dots



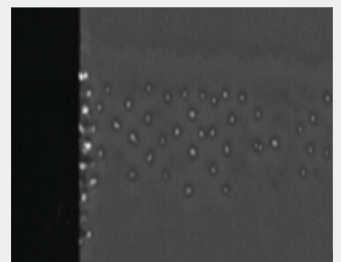
Decontamination



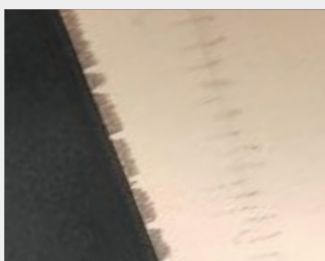
Voids, pinholes



Leaked out material



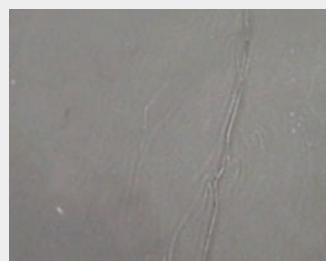
Pinhole shaped leak out



Smear



Dropped off coating



Scratches, wrinkles



Embedded particle

Image capturing: 100% precise & fast.

Reliable inspection results require high-speed image capture in addition to flexibly adaptable lighting scenarios. To record even the highest web speeds in maximum resolution, we only use the latest camera technology available on the market. In addition, FPGA enables real-time recording, e.g. for error marking. We pass on every further development directly to our customers.

To lower costs in the course of complying with dry room requirements or after slitting, having the smallest possible installation space for integrating the inspection solution in the machine is crucial. Here for example, we are setting standards with the optional CIS sensor technology: it requires minimal space, despite the integrated lighting unit. In addition, the optional CIS sensor enables lower image distortion in the peripheral area of the image.

Minimal footprint for maximum quality

Flexible installation

Line scan camera mounted on frame.



The software: 100% reliable and intuitive.

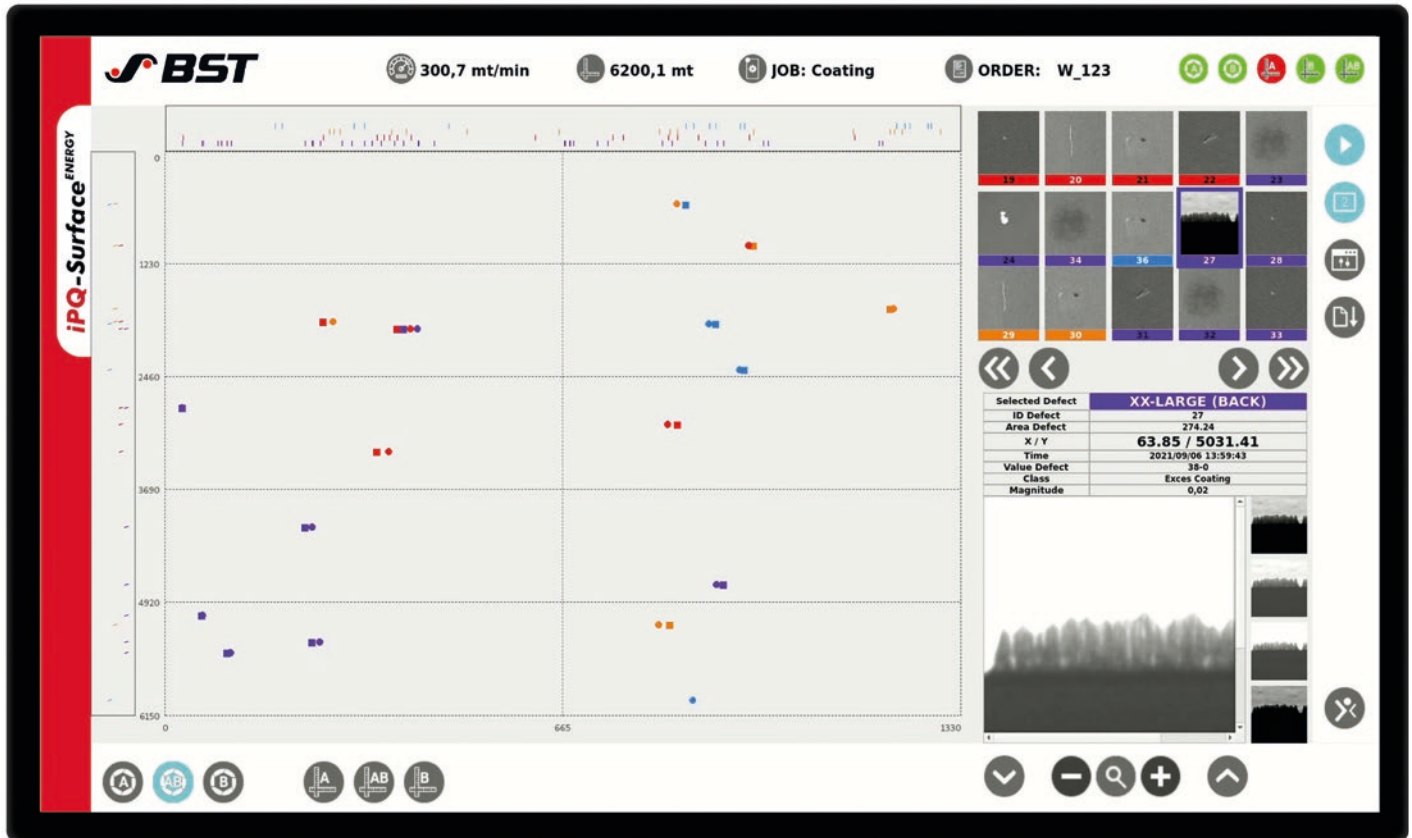
With numerous interfaces, intuitive operation and a flexible architecture, our software solutions are perfectly designed for use in networked Industry 4.0 environments. By quickly switching views between Live Mode, Defect Map, Measurement Task and Measurement Results, all the key information is always available to you at a glance. With multiple monitors, you can also display the different views in parallel. Switching to new tasks and jobs is both quick and self-explanatory. The latest AI-based classifiers separate the crucial defects

from the irrelevant ones, and are the basis for meaningful quality evaluations that enable you to draw the right conclusions for process optimization and avoid waste.

To sustainably improve quality and productivity even with software support, having a digital workflow with position-accurate traceability is one of the system's key factors: this not only creates a digital twin of each web, but this solution also makes position-accurate interactions between processes possible.

Moreover, the **BST iPQ Surface^{ENERGY}** software also offers you the following benefits:

- » Creating role reports
- » Tagging function
- » Analyzing and processing defect cards
- » Validating the post process
- » Synchronizing between process steps
- » Tracing and eliminating defects
- » Self-diagnosis functions for predictive maintenance



On the BST iPQ-Surface^{ENERGY} user interface, you can always see an overview of the inspection results or the defect map, for example, thanks to the various views available.

BST services: 100% competent & personal.

Each BST iPQ-Surface^{ENERGY} installation is a custom-fit combination of standardized modules and application-specific elements. This means the system will fit perfectly into your machine, both from a functional and design point of view and thus best meets your requirements.

And of course, our outstanding service doesn't come to an end following installation. In an ideal world, it is only the first milestone in our partnership. We build on this as equals,

with mutual respect and appreciation. This also means that we are there for you promptly when you need us. After all, we want you to become (even) better with BST. Our promise also reflects this: **perfecting your performance**

Application expertise from BST

- » In-depth process understanding
- » Over 30 years of experience in inspection technology
- » Passionate about innovative technology

BST: global presence, local roots

- » Experts available at all times in over 80 countries
- » Responsive and experienced service technicians
- » Solution-oriented support

Outstanding and fair services

- » You have the choice: Service at cost or comfortable service packages based on your requirements.
- » We test your material on our systems in the BST test center.



Your benefits at a glance: 100% the right decision.



Machine manufacturer-independent:

For ideal comparability of your quality data across different machines or systems.



Over 30 years of experience in inspection technology:

As an example, BST developed the world's first banknote inspection system.



Less waste:

Clear defect classifications allow operators to correct them quickly. Pseudo errors are avoided by intelligent classification.



Optimized overall system effectiveness:

Short set-up times thanks to fast system set-up and simple operation. Measurable quality also prevents excess production.



Predictive quality:

By networking different BST systems, quality deviations can be eliminated before they even occur.



Predictive maintenance:

The solution's self-diagnostic capability paves the way for predictive maintenance.

Web-position-accurate quality data mapping: 100% better positioned.

Thanks to web-position-accurate quality data mapping, your benefits include:



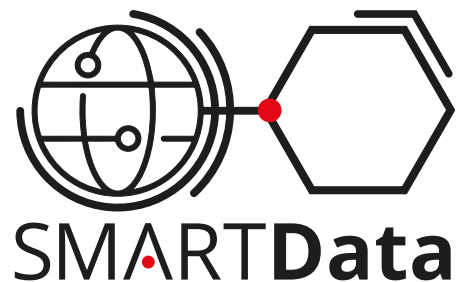
Mapping a digital twin enables sustainable battery cell production with maximum transparency across different manufacturing processes.



Reducing the total cost of ownership (TCO) since only flawless material is used in the end product.



Increasing the overall equipment effectiveness (OEE) through process optimization, based on the continuous acquisition of process data and quality information.





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