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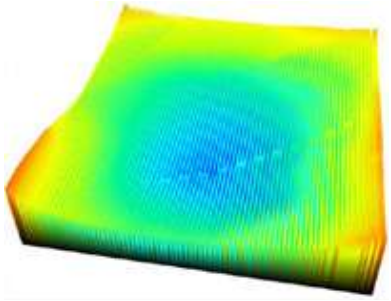
High-Definition Metrology and Vision Application Note #09-11

Advanced Battery and Fuel Cell Component Dimensional Quality Assurance

The Engineering and Manufacturing Challenge

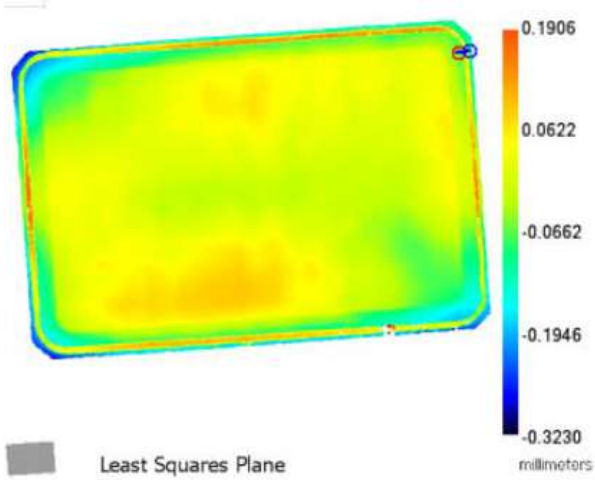


Lithium-ion battery and fuel cell developers and manufacturers face a number of challenges to meet the requirements for hybrid and electric vehicles in the immediate future and beyond. They must achieve the most positive combination of four critical factors in their components. These four factors are component reliability, component service life, power density and manufacturing cost competitiveness. In addition to material and electro-chemical issues, dimensional integrity is vital. Over-all dimensions, detailed surface geometries, surface finish and surface defects, any of which may vary from component to component, can all adversely affect any of these critical factors. The sub-components making up a battery or fuel cell are each potential "Achilles heels" of a final assembled unit.

The Metrology Need

Batteries and fuel cells, and their subordinate components, are being developed and refined with high intensity at many locations around the globe to meet demands for lower fossil fuel consumption and reduced emissions, while meeting needs for consumer-acceptable range and delivered vehicle horsepower. In order to maximize development speed and enable the cost of manufacturing to be minimized, the processes for fabricating and assembling battery cells, separators and electrodes must be optimized. Similarly the rate of penetration of fuel cell technology into the automotive and other vehicle industry will critically depend upon the bipolar plates and separators of those systems being fabricated and assembled with high yields and assured performance. The metrology needs for these diverse components cut across the domains of surface topography (flatness, waviness, edge quality and shape). They also include measurement of feature locations, dimensions and shapes, and detection of presence/absence. Finally, assured battery and fuel cell performance requires surface defect detection and the measurement of thickness and completeness of critical coatings.

The Measurement Requirements

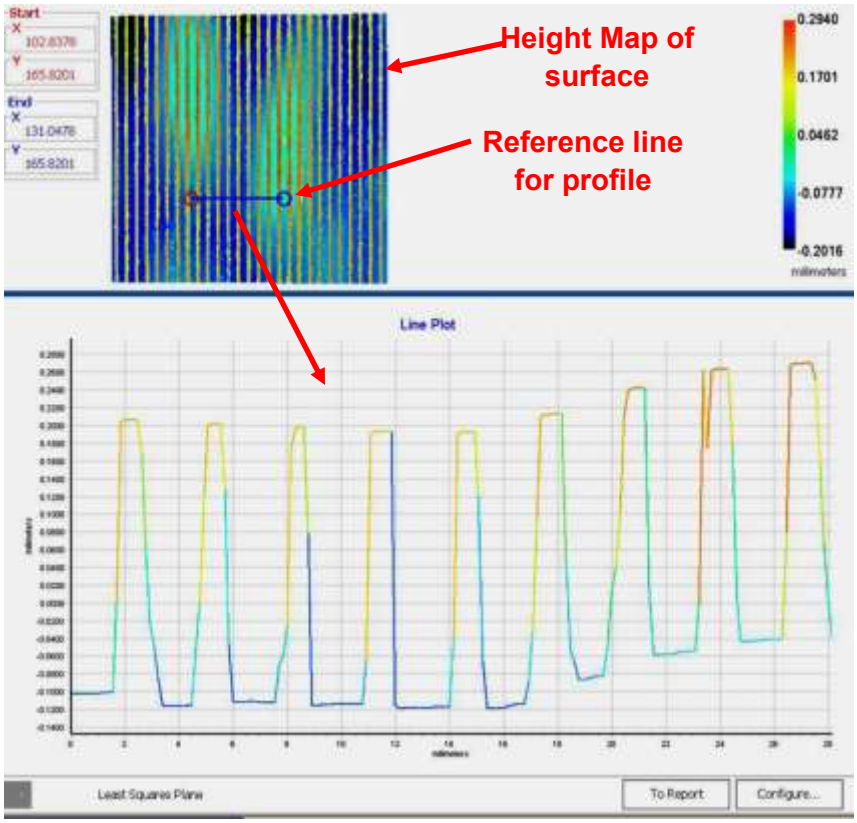


This wide variety of critical dimensions and surface characteristics requires the employment of equally diverse and powerful high-definition measurement capabilities that deliver micron-level or better resolution in all three dimensions of measurement. Sensing and metrology are also required to capture the technical "signatures" of materials and surfaces in which both feature-rich and featureless part attributes are measured. Multispectral characteristics also play a significant role. Each component manufacturer's unique technology variant requires its particular mix of illumination, sensing, sensor processing and analysis functions to be robustly automated and deployed.

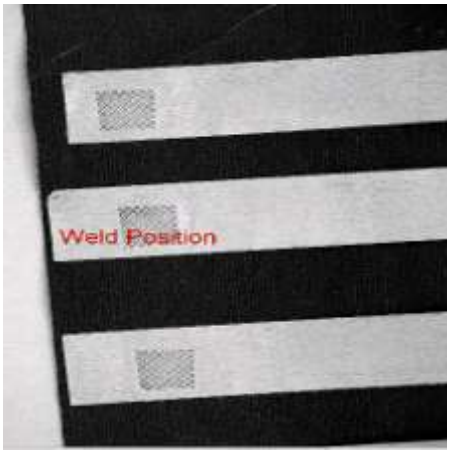
The Coherix Solution

Coherix applies both of its platform technologies for high-definition 3-dimensional metrology to cover all types of dimensional surface measurement of battery and fuel cell components. The first of these technology platforms is the **ShaPix Surface Detective™**, the holographic high-definition surface topology measurement family. For battery and fuel cell applications, this technology is configured to detect and measure features and defects down to 15 microns along a surface and to produce surface flatness and waviness height measurements along formed surface areas or fesatures as narrow as a fraction of a millimeter. The second ***Coherix*** 3-D technology platform is the ***I-Cite*** machine vision platform that enables fast multi-camera multi-wavelength stereo measurement of features and defects to the micron level. Together, these two platforms are used to meet the needs of battery and fuel cell developers and manufacturers for rapid, high-definition, 3-D measurement of their unique technologies and processes at all manufacturing process steps.

The *Coherix* Results



In the figure at the left, the **ShaPix Surface Detective™** shows, in an immediately obvious visual form, all of the information needed by the engineering or manufacturing user regarding the surface height of a fuel cell component. This is displayed for any chosen contour, such as the line indicated on the height map. Other surface characteristics, such as features or defects, can be set up for measurement in minutes and measured in less than1 minute using a combination of ***I-Cite*** and ***ShaPix*** technologies. The figure below illustrates high-speed inspection of battery electrode welds using ***I-Cite*** technology.



The *Coherix* Value Delivered

The "bottom-line" values delivered by the combined ***Coherix*** 3-D measurement technology platforms are:

- Acceleration of battery and fuel cell engineering development and integration programs
- Rapid convergence to economical high-quality, and high-performance battery and fuel cell production.