

**Non-Destructive Testing to Ensure Quality and Reduce the Cost of Manufacturing for Batteries and Ultracapacitors**

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The goal of the presented work was to develop and commercialize the proprietary non-destructive testing (NDT) methods and systems for non-contact evaluation of the properties of the initial materials, semi- and final products in manufacturing of batteries and ultracapacitors.

The following methods were developed and used: electromagnetic eddy-current and capacitance; ultrasonic echo and pulse shadow; holographic interferometry; high voltage gas visualization; combined methods.

The safety and reliability of a battery are determined mainly by its basic design and chemistry. However, without adequate quality control during manufacture, defects in even the best designs can lead to inconsistent performance and early failure.

Deployment of automated non-destructive quality assurance technology at every stage of the manufacturing and assembly process will increase the reliability and safety of cells and batteries while lowering overall manufacturing costs by reducing wastage and preventing defective components from being incorporated into the finished product.

Continuous application of appropriate non-destructive testing procedures to materials and components before, during, and after the manufacturing process is the most cost effective method to achieve the highest possible product quality and reliability

The major advantages of the non-destructive non-contact testing methods developed by the authors of the paper are as following: reliability due to non-contact mode of operation; efficient, fast, simple and inexpensive to implement; easy to automate; results are obtained in real-time; do not require any special protection for operators and equipment; safe and less expensive than X-ray methods; precise determination of specific defects; provides 100% nondestructive control of the technological operations and the quality of the end product; quality control of material and products for which contact methods, in principle, cannot provide reliable information due to extraneous processes at the sensor/test article interface surface; quality control of properties of new materials including nanomaterials and thin-layered materials, which can be sensitive to mechanical contact.

During the presentation will be presented NDT methods and systems developed by Enerize for the following purposes: electromagnetic testing conductivity; electromagnetic properties and composition of powdered materials; non-contact nondestructive electromagnetic testing of specific conductivity of thin films (solid and polymer electrolytes, polymer membranes for fuel cells,

etc.); non-contact electromagnetic testing of interface resistance between current collector and active electrode mass; non-contact holographic interferometry defects in batteries and other devices; nondestructive determination of defects in multilayer structures based on combined ultrasonic and electromagnetic methods (e.g., "jelly-rolls" for batteries and supercapacitors); gas-discharge visualization system for hermetic seal quality control and other.

The non-contact feature of these methods allows in-line quality control during synthesis of component materials as well as during production and final assembly of batteries, supercapacitors, etc. Application of these systems results in improved product reliability and safety, while lowering overall manufacturing costs by reducing wastage and preventing defective components from being incorporated into the finished product.