Development of diagnostic imaging system for electric current density distribution inside storage battery for the first time in the world -Dramatically improved safety through inspection of all storage batteries-

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New Energy and Industrial Technology Development Organization
Integral Geometry Science Co., Ltd.
Kobe University

In the NEDO project, Integral Geometry Science Co., Ltd. and Center for Mathematical and Data Sciences of Kobe University have succeeded for the first time in the world in developing a system for nondestructively diagnosing electric current density distribution in real time by measuring the spatial distribution of the magnetic field through analysis of the inverse problem of the electric current inside the storage area and the magnetic field leaking to the outside of the storage battery.

This technology can detect non-uniform electric current density even in non-defective storage batteries. In the future, while the production of storage batteries is expected to increase with the spread of electric vehicles, it is possible to dramatically improve the safety of storage batteries if inspection in the manufacturing process of all storage batteries is established.

Integral Geometry Science Co., Ltd. will start selling in-line 100% inspection systems capable of inspection in manufacturing processes within the next two years.

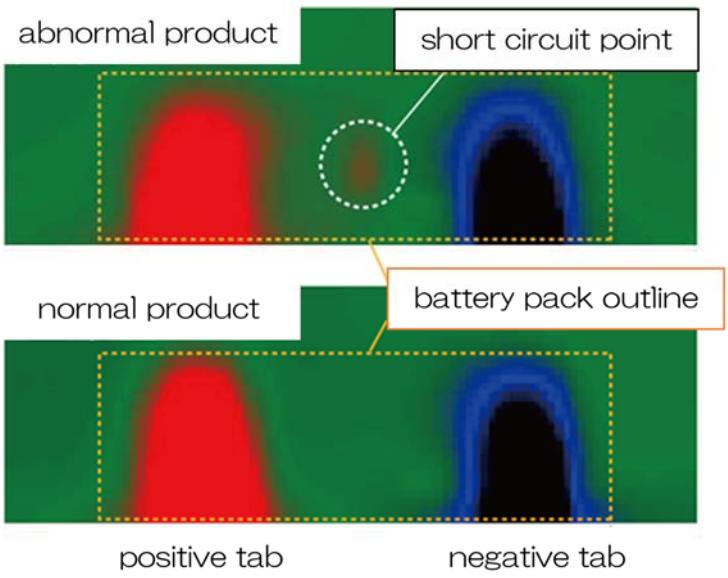

figure1　Diagnostic imaging of electric current density distribution inside storage

1. Overview

To support ventures and small and medium-sized businesses aiming to commercialize in the new energy field, New Energy and Industrial Technology Development Organization (NEDO) is engaged in technology research and development aimed at finding and commercializing new energy seeds.

In this project of 2018, Integral Geometry Science Co., Ltd. and Center for Mathematical and Data Sciences of Kobe University worked on a technology development that nondestructively diagnoses the electric current density distribution inside the storage battery in real time. As a result, from the measurement data of the spatial distribution of the magnetic field generated during charge and discharge, they have derived an analytical solution for the inverse problem that leads to the electric current density distribution inside the storage battery for the first time in the world. Also, they developed a system (FOCUS) that displays and diagnoses the electric current density distribution of storage batteries as an image.

With this technology, it is possible to detect unevenness in electric current density even in a non-defective storage battery. Furthermore, it is possible to dramatically improve the safety of storage batteries if 100% inspection in the manufacturing process of storage batteries is established while the production of storage batteries is expected to increase due to the spread of electric vehicles.

This result will be exhibited at Academic Plaza（JPCA Show @Tokyo Big Sight）from June 5 to June 7, 2019.

2. This achievement

Storage batteries that have been shipped as non-defective products cause problems such as ignition accidents, and the causes and their prevention measures have become issues. As one of the causes of ignition accident etc., It is possible that the electric current density inside the storage battery at the time of shipment is spatially uneven, and the degree gradually increases with the charge and discharge of the storage battery, eventually resulting in short circuit and ignition. Therefore, there is a need for a technology that can accurately measure the electric current density distribution of storage batteries before shipping.

In the developed technology, the electric current density distribution inside the storage battery is measured by measuring the spatial distribution of the magnetic field generated around when electric current flows. Although it has been possible to mathematically derive the spatial distribution of the magnetic field from the electric

current density distribution (forward problem), it is very difficult to derive the electric current density distribution from the spatial distribution of the magnetic field (inverse problem), therefore, it was not realized.

Since the distance between the positive and negative electrodes can be regarded as infinitely smaller than the size of the battery electrode, the three-dimensional electric current flowing in the storage battery can be considered to be confined between thin parallel plates. Hence, by incorporating this into the basic equation of static magnetic field in the storage battery, we succeeded in solving the inverse problem analytically for the first time in the world.

Furthermore, by developing a device that measures the spatial distribution of the magnetic field in real time by arranging the magnetic sensors in two dimensions, and performing an analysis of the inverse problem from the measured magnetic field, they developed a system that visualizes the electric current density distribution nondestructively in real time.

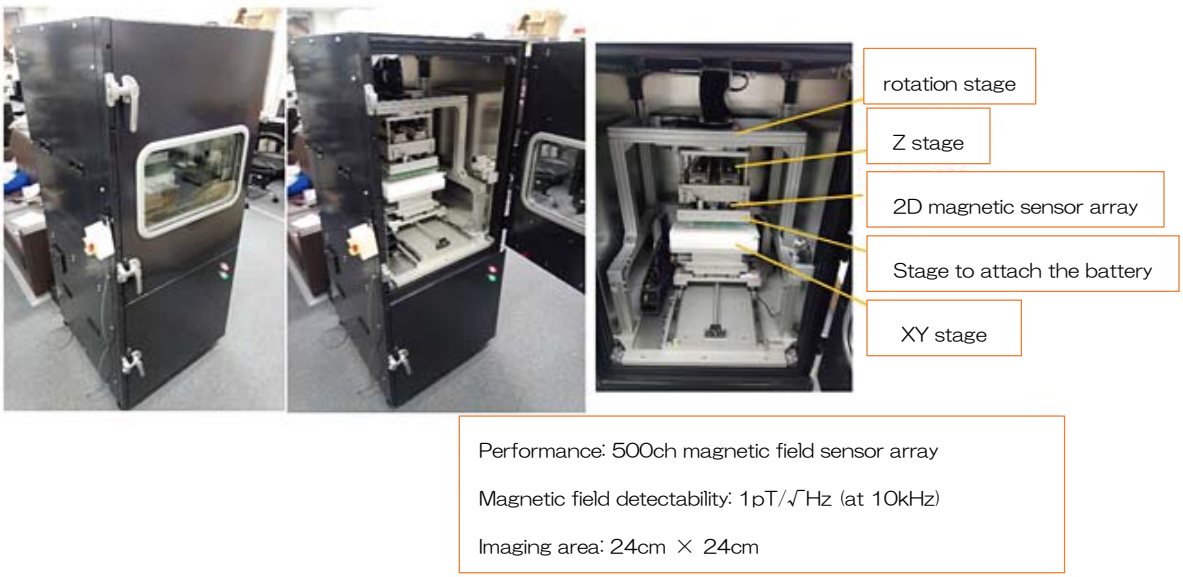

figure2　FOCUS that displays and diagnoses the electric current density distribution of storage batteries as an image

3. Future works

In the NEDO project, Integral Geometry Science Co., Ltd. and Center for Mathematical and Data Sciences of Kobe University Kobe University will continue research and

development in cooperation with storage battery manufacturers, which are users, in order to optimize specifications as an in-line inspection system.

Integral Geometry Science Co., Ltd. will start selling in-line inspection systems that can perform 100% inspection in manufacturing processes. within two years.

4. Contact information

(Contact for technical details in this news release)

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