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TECHNICAL SPECIFICATION

colour inside

Nanomanufacturing – Key control characteristics – Part 4-3: Nano-enabled electrical energy storage – Contact and coating resistivity measurements for nanomaterials

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Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 62607-4-3, which is a Technical Specification, has been prepared by IEC technical committee 113: Nanotechnology standardization for electrical and electronic products and systems.

The text of this Technical Specification is based on the following documents:

Enquiry draft	Report on voting
113/239/DTS	113/263A/RVC

Full information on the voting for the approval of this Technical Specification can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62607 series, published under the general title *Nanomanufacturing – Key control characteristics*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- transformed into an International Standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The future utilization of renewable energy technologies including e-mobility for individual transportation significantly depends on the development of efficient systems for energy storage. From today's perspective, lithium-ion batteries, supercapacitors and their derivative concepts are regarded as the most promising innovative candidates.

A high energy density for the desired power and a long life time (recharge characteristics) are the two most important criteria for electrode materials. Because many electrochemically active materials such as metal oxides show an inherently lower and insufficient conductivity for the electron transport, composite materials with carbon nanomaterial content are used for optimization of the current flow in the electrodes of a battery. The electrochemical reactions and the ensuing energy density of the battery cells are influenced by the movement of electrons in a composite. Furthermore, the electronic contact resistivity between the electrode material and the metal collector is important to realize a low ohmic internal resistance of the battery or capacitor device.

This part of IEC 62607 provides standard methods to measure coating and contact resistivity of nano-enabled electrode materials and to evaluate the best combinations of the composite material recipes and fabrication technologies for carbon containing coatings of such nano-enabled electrodes. Following this method will allow comparison of the results of different research groups.

This standardized method is intended for comparing the contact and coating resistivity of composite materials with carbon nanomaterial content in the study stage, not for evaluating the electrode in end products.

The method is applicable for nano-enabled materials exhibiting function or performance only possible with nanotechnology, intentionally added to composite materials for measurable and significant improvement of the current flow in the electrodes of electrical energy storage devices.

In this context it is important to note that the percentage content of nanomaterial of the device in question has no direct relation to the applicability of this part of IEC 62607, because minute quantities of nanomaterial are frequently sufficient to improve the performance significantly.

The fraction of nanomaterials in electrodes, electrode coatings, separators or electrolyte is not of relevance for using this method.

NANOMANUFACTURING – KEY CONTROL CHARACTERISTICS –

Part 4-3: Nano-enabled electrical energy storage – Contact and coating resistivity measurements for nanomaterials

1 Scope

This part of IEC 62607 provides a standardized test method for the measurement of contact and coating resistivity of nano-enabled electrode materials. This method will enable a customer to:

a) decide whether or not a coating composite material is usable, and

b) select best combinations of coating composite material with fabrication technologies suitable for their application.

This part of IEC 62607 includes:

– definitions of terminology used in this part of IEC 62607,

– recommendations for sample preparation,

– outlines of the experimental procedures used to measure and calculate the contact and coating resistivity,

– methods of interpretation of results and discussion of data analysis, and

– a case study.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TS 80004-1, *Nanotechnologies – Vocabulary – Part 1: Core terms*

3 Terms, definitions, acronyms and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 80004-1 and the following apply.

3.1.1
electrode nanomaterial
material used in nano-enabled energy storage devices such as lithium-ion batteries or super-capacitors which contains a fraction of nanomaterial and exhibits function or performance made possible only with the application of nanotechnology

Note 1 to entry: Electrodes used in lithium-ion batteries or supercapacitors consist of mixed raw material powders (e.g. electrochemical active and carbon based nanomaterial powders) in a solvent with binder which forms a casting slurry. These slurries are coated by doctor blade process on thin metal collector foils, dried and subsequently calendar compressed to the final electrode. The electrode shows a multilayered layout, built up of (1) an aluminium or copper current collector and (2) the electrode material layer. This material layer consists of the active phase (cathode – lithium containing mixed oxides or phosphate, e.g. LCO, NCA, NCM, and LFP; anode, e.g. graphite and supercap – activated carbon), a conducting phase (e.g. carbon nanomaterials like CB, carbon nanotubes or fibres) and an organic binder (e.g. PVDF or SBR).