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BSI Standards Publication

Nanomanufacturing — Key control characteristics

Part 4-6: Nano-enabled electrical energy storage — Determination of carbon content for nano-enabled electrode materials, infrared absorption method

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee NTI/1, Nanotechnologies.

A list of organizations represented on this committee can be obtained on request to its secretary.

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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.

International Standard IEC 62607-4-6 has been prepared by IEC technical committee 113: Nanotechnology for electrotechnical products and systems.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
113/379/DTS	113/402/RVDTS

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 document 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 document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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

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INTRODUCTION

Electrical energy storage devices have been utilized in many applications such as portable electronics, electric vehicles and aircraft. Rapid development in these markets poses great demand for high-performance devices, in which the main properties are determined by their electrode materials.

Carbon content has significant influence on the performance and quality of electrode material. Carbon serves as a conductive agent improving interparticle electron conduction performance, therefore a suitable amount of carbon is necessary. When its amount is not enough, it is possible the conductivity will not improve effectively and this causes high internal resistance, low discharge platform or low capacity, which can result in bad rate performance and cycling life. On the other hand, high carbon content can have a tendency to aggregate and be hard to separate, which may introduce factory processing problems. Superfluous carbon can influence the power density of the batteries as carbon has relatively low specific capacity.[1][2]1

However, nano-sized powder can be easily flowed away with gas flow in the furnace chamber, which influences the determination of carbon content and may contaminate the test system.

This document provides a method to measure the carbon content of nano electrode materials that will be employed in electrical energy storage devices, and to evaluate the best combinations of composite material recipes of nano electrodes. Following this method will allow comparison of the results of different research groups.

This method is intended for comparing the carbon content of composite materials with cathode nanomaterials in the study stage, not for evaluating the electrode in end products.

The method is applicable for nano materials exhibiting function or performance only possible with nanotechnology, intentionally added to composite materials for improvement in the performance of electrical energy storage devices.

1 Numbers in square brackets refer to the Bibliography.

NANOMANUFACTURING – KEY CONTROL CHARACTERISTICS –

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1 Scope

This part of IEC 62607, which is a Technical Specification, provides a method for determination of carbon content of nano electrode materials by infrared absorption spectroscopy method. The method is applicable to carbon contents of mass fraction between 0,001 % and 100 %.

This method will enable customers to:

a) decide whether or not a nano electrode material is usable, and

b) select a nano electrode material with suitable carbon content for its application.

This document includes:

– recommendations for sample preparation,

– outlines of the experimental procedures used to measure electrode nanomaterial properties,

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

– case studies.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC TS 62607-4-2:2016, *Nanomanufacturing – Key control characteristics – Part 4-2: Nano-enabled electrical energy storage – Physical characterization of cathode nanomaterials, density measurement*

ISO/TS 80004-1:2010, *Nanotechnologies – Vocabulary – Part 1: Core terms*

3 Terms, definitions and abbreviated terms

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.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp