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PD IEC/TS 62607-4-5:2017



BSI Standards Publication

Nanomanufacturing — Key control characteristics

Part 4-5: Cathode nanomaterials for
nano-enabled electrical energy storage —
Electrochemical characterization, 3-electrode
cell method

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This Published Document is the UK implementation of IEC/TS 62607-4-5:2017.

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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Published by BSI Standards Limited 2017

ISBN 978 0 580 91371 6
ICS 07.030; 07.120

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 28 February 2017.

Amendments/corrigenda issued since publication

Date	Text affected
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Edition 1.0 2017-01

TECHNICAL SPECIFICATION



**Nanomanufacturing – Key control characteristics –
Part 4-5: Cathode nanomaterials for nano-enabled electrical energy storage –
Electrochemical characterization, 3-electrode cell method**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 07.030; 07.120

ISBN 978-2-8322-3766-3

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

NANOMANUFACTURING – KEY CONTROL CHARACTERISTICS –

Part 4-5 Cathode nanomaterials for nano-enabled electrical energy storage – Electrochemical characterization, 3-electrode cell method

FOREWORD

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The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a Technical Specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

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

IEC TS 62607-4-5, which is a Technical Specification, has been prepared by IEC technical committee 113: Nanotechnology standardization for electrical and electronic products and systems.

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

Enquiry draft	Report on voting
113/317/DTS	113/342/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 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

- 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.

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INTRODUCTION

The future utilization of renewable energy technologies depends significantly on the development of efficient systems for energy storage. Conventional approaches exist for the storage of electrical energy from stationary power plants, currently fuelled by many new ideas in conjunction with the emerging "Smart Grid". For future e-mobility for individual transportation there is only one attractive solution: a battery that can store enough energy to allow all-electric driving with a range of several hundred kilometres. The current solutions already on the market can only be seen as temporary solutions. From today's perspective, lithium-ion batteries and their derivative innovative concepts are regarded as the most promising candidates. Electrodes made from nanoscale composites will play a key role in the future. Innovative materials will be developed and systematically optimized, which implies testing of a large number of different materials.

Characterization of the electrochemical properties of cathode nanomaterials used in electrical energy storage devices is important for their customized development. This document provides a standard methodology which can be used to characterize the electrochemical properties of new cathode nanomaterials that will be employed in electrical energy storage devices. Following this method will allow comparison of different types of cathode nanomaterial and comparing the results of different research groups.

This document introduces a 3-electrode cell method for the electrochemical characterization of nano-enabled cathode materials for electrical energy storage devices.

This standardized method is intended for use in comparing the characteristics of cathode nanomaterials in the development stage, not for evaluating the electrode in end-products.

The method is applicable to materials exhibiting function or performance only possible with nanotechnology, intentionally added to the active materials to measurably and significantly change the capacity 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 document, 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.

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NANOMANUFACTURING – KEY CONTROL CHARACTERISTICS –

Part 4-5 Cathode nanomaterials for nano-enabled electrical energy storage – Electrochemical characterization, 3-electrode cell method

1 Scope

This part of IEC 62607 provides a standardized method for the determination of electrochemical properties of cathode nanomaterials such as lithium iron phosphate (LFP) for electrical energy storage devices. This method will enable the industry to:

- a) decide whether or not a cathode nanomaterial is usable, and
- b) select a cathode nanomaterial suitable for their application.

This document includes:

- recommendations for sample preparation,
- outlines of the experimental procedures used to measure cathode nanomaterial properties,
- methods of interpretation of results and discussion of data analysis, and
- case studies.

NOTE The very purpose of this method is to arrive at a detailed characterization of the electrodes so that individual contribution of the anode and cathode for performance and degradation could be predicted. The method can be applied for characterization of the electrode working as cathode or/and as anode.

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.

ISO/TS 80004-1, *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>

3.1.1

cathode nanomaterial

material used as a cathode in a nano-enabled energy storage device which contains a fraction of nanomaterial and exhibits function or performance made possible only with the application of nanotechnology