

TECHNICAL SPECIFICATION



**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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INTERNATIONAL
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CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references	7
3 Terms, definitions and abbreviated terms	7
3.1 Terms and definitions.....	7
3.2 Abbreviated terms.....	9
4 Sample preparation methods	9
4.1 General.....	9
4.2 Reagents	9
4.2.1 Cathode foil.....	9
4.2.2 Anode foil	10
4.2.3 Reference electrode	10
4.2.4 Electrolyte and separator.....	10
4.3 Pre-treatment of the electrode materials	10
4.4 Preparation of the screw cell.....	11
4.5 Disassembly of the screw cell	12
5 Measurement of electrochemical properties.....	12
5.1 General.....	12
5.2 Open circuit potential	12
5.2.1 Demarcation of method.....	12
5.2.2 Experimental procedures and measurement conditions.....	12
5.3 Potentiostatic electrochemical impedance spectroscopy (EIS)	13
5.3.1 Demarcation of method.....	13
5.3.2 Experimental procedures and measurement conditions.....	13
5.4 Charge-discharge experiment (Constant Current Constant Voltage, CCCV/CC)	13
5.4.1 Demarcation of method.....	13
5.4.2 Experimental procedures and measurement conditions.....	13
6 Data analysis / interpretation of results (see Figure A.7).....	14
6.1 Open circuit potential.....	14
6.2 Electrochemical impedance spectroscopy	14
6.3 Constant current constant voltage (CC CV) charging-discharging	14
Annex A (informative) Case study	16
A.1 Sample preparation.....	16
A.2 Results for a LFP electrode.....	19
A.2.1 Open circuit voltage/potential (OCV/P)	19
A.2.2 Electrochemical impedance spectroscopy (EIS)	19
A.2.3 Constant current constant voltage (CCCV/CC) charging-discharging	20
A.2.4 Ageing tests	20
Figure A.1 – 3-electrode screw cell	16
Figure A.2 – Components of the electrochemical cell used for testing	16
Figure A.3 – 3-electrode screw cell assembling steps	18
Figure A.4 – Open circuit voltage/potential (OCV/P).....	19

Figure A.5 – Electrochemical impedance spectra	19
Figure A.6 – Constant current constant voltage (CCCV/CC) charging-discharging	20
Figure A.7 – Comparison of results of ageing tests using 3-electrode screw cell	22

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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 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.

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.

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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.

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