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TECHNICAL SPECIFICATION

colour inside

Nanomanufacturing – Product specifications – Part 5-1: Nanoporous activated carbon – Blank detail specification: Electrochemical capacitors

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NANOMANUFACTURING – PRODUCT SPECIFICATIONS –

Part 5-1: Nanoporous activated carbon – Blank detail specification: Electrochemical capacitors

FOREWORD

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IEC TS 62565-5-1 has been prepared by subcommittee 113: Nanotechnology for electrotechnical products and systems. It is a Technical Specification.

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

Draft	Report on voting
113/715/DTS	113/742/RVDTS

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 62565 series, published under the general title *Nanomanufacturing – Product specifications*, can be found on the IEC website.

Future documents in this series will carry the new general title as cited above. Titles of existing documents in this series will be updated at the time of the next edition.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under 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- withdrawn,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.

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INTRODUCTION

This document specifies how to report the various characteristics of nanoporous activated carbon for electrochemical capacitors, and how to incorporate these into a bilateral detail specification between vendor and user.

Electrochemical capacitors are widely used in the fields of electric vehicles, high speed trains, airplanes, photovoltaics, wind power and electronics, due to their ultra-fast charge and discharge capability, long cycle life, wide working temperature range, high security reliability and low maintenance cost [1] [1]. Nanoporous activated carbon is the active material in electrochemical capacitors [2], [3], [4] (Figure 1), and is one of the most critical factors that determine the electrochemical performance of a device.

Both precursor and process will affect the chemical, physical and structural characteristics of nanoporous activated carbon remarkably. The precursor of nanoporous activated carbon can be biomass, pitch and resin. The production process can be gas activation using diluted oxygen gas, steam, CO_2, etc., or chemical activation using H_3PO_4, $ZnCl_2$, KOH, etc. The chemical, physical and structural key control characteristics (KCCs) will significantly affect the electrochemical performance of nanoporous activated carbon. For instance, the metallic impurities will affect the self-discharging and endurance in cycling, the pore size distribution will affect the specific capacitance and the DC resistance. However, not all relationships between the chemical, physical, structure and application properties of active materials are clear so far. In the commercial market, the KCCs will be good indicators to choose an appropriate nanoporous activated carbon. Therefore, it is important to report KCCs, including electrochemical characteristics.

For nanoporous activated carbon manufacturers, the accurate characterization is critical for product optimization, finalization and quality control. For electrochemical capacitor manufacturers, who use the nanoporous activated carbon, before the large-scale production of electrochemical capacitors, the correct and accurate characterization of KCCs can be good indicators for choosing the appropriate raw materials and achieving quality assurance

To permit common processing equipment and common unit processes with predictable and reproducible results to be used in different fabrication lines, it is important for nanoporous activated carbon characteristics to be described and assessed in a proper manner and to standardize the methods for quality control of the manufacturing processes.

In this document, the key chemical, physical, structural and electrochemical characteristics that will significantly influence the performance of electrochemical capacitors are listed. This document also provides information about measurement methods and existing standards concerning the correct determination of KCCs.

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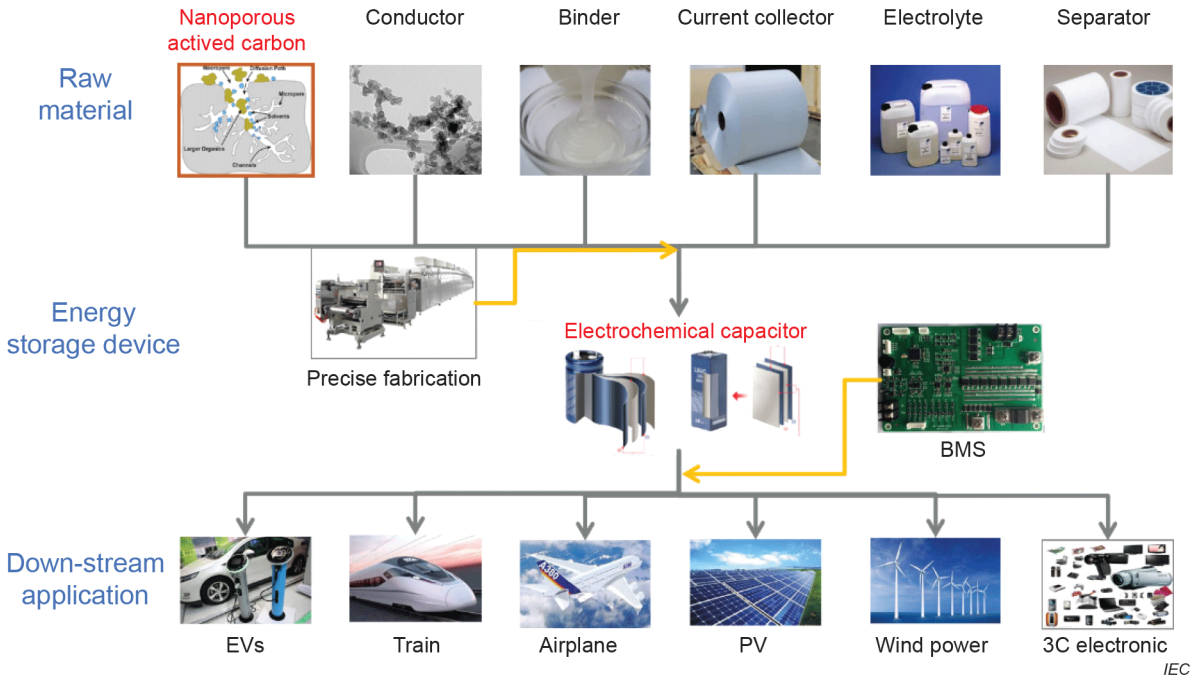
1 Numbers in square brackets refer to the Bibliography.



Key

BMS battery management system

EVs electrical vehicles

PV photovoltaic power

3C computer, communication and consumer electronics

Figure 1 – Industrial chain of electrochemical capacitor

NANOMANUFACTURING – PRODUCT SPECIFICATIONS –

Part 5-1: Nanoporous activated carbon – Blank detail specification: Electrochemical capacitors

1 Scope

This part of IEC 62565, which is a Technical Specification, establishes a blank detail specification (BDS) for

- nanoporous activated carbon

used for

- electrochemical capacitors

Numeric values for the key control characteristics are left blank as they will be specified between customer and supplier in the detail specification (DS). In the DS key control characteristics can be added or removed if agreed between customer and supplier

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions 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 General terms

3.1.1
nanomanufacturing
intentional synthesis, generation or control of nanomaterials, or fabrication step in the nanoscale, for commercial purposes

[SOURCE: ISO/TS 80004-1:2015, 2.11]

3.1.2
key control characteristic
KCC
material property or intermediate product characteristic which can affect safety or compliance with regulations, fit, function, performance, quality, reliability or subsequent processing of the final product

Note 1 to entry: The measurement of a key control characteristic is described in a standardized measurement procedure with known accuracy and precision.

Note 2 to entry: It is possible to define more than one measurement method for a key control characteristic if the correlation of the results is well-defined and known.

3.1.3
product specification
structured document which describes all characteristics of a product known to be relevant for applications of that product

3.1.4
blank detail specification
BDS
structured generic specification providing a comprehensive set of key control characteristics which are needed to describe a specific nano-enabled product without assigning specific values and/or attributes

Note 1 to entry: Examples of nano-enabled products are: nanomaterials, nanocomposites and nano-subassemblies.

Note 2 to entry: Blank detail specifications are intended to be used by industrial users to prepare their detail specifications used in bilateral procurement contracts. A blank detail specification facilitates the comparison and benchmarking of different materials. Furthermore, a standardized format makes procurement more efficient and more error robust.

3.1.5
detail specification
DS
specification based on a blank detail specification with assigned values and attributes

Note 1 to entry: The properties listed in the detail specification are usually a subset of the key control characteristics listed in the relevant blank detail specification or sectional blank detail specification. The industrial partners define only those properties which are required for the intended application.

Note 2 to entry: Detail specifications are defined by the industrial partners. SDOs will be involved only if there is a general need for a detail specification in an industrial sector.

Note 3 to entry: The industrial partners may define additional key control characteristics if they are not listed in the blank detail specification or sectional blank detail specification.

3.1.6
measurand
quantity intended to be measured

Note 1 to entry: If the quantity is a key control characteristic, the measurement is an essential part of the quality management system.

3.1.7
measurement method
process of experimentally obtaining one or more values that can reasonably be attributed to a quantity

Note 1 to entry: If the quantity is a key control characteristic, the measurement is an essential part of the quality management system.

3.1.8
measurement principle
phenomenon serving as a basis of a measurement

EXAMPLE 1: Thermoelectric effect applied to the measurement of temperature.

EXAMPLE 2: Energy absorption applied to the measurement of amount-of-substance concentration.

EXAMPLE 3: Hall effect applied to the measurement of magnetic flux density.

Note 1 to entry: The phenomenon can be of a physical, chemical, or biological nature.

[SOURCE: IEC 60050-112:2010, 112-04-03]

3.1.9
measurement procedure
detailed description of a measurement according to one or more measurement principles and to a given measurement method, based on a measurement model, and including any calculation to obtain a measurement result

Note 1 to entry: A measurement procedure is usually documented in sufficient detail to enable an operator to perform a measurement.

Note 2 to entry: A measurement procedure can include a statement concerning a target measurement uncertainty.

Note 3 to entry: A measurement procedure is sometimes called a standard operating procedure, abbreviated SOP.

[SOURCE: ISO/IEC Guide 99:2007, 2.6]

3.1.10
measurement result
set of quantity values being attributed to a measurand together with any other available relevant information

Note 1 to entry: A measurement result is generally expressed as a single measured quantity value and a measurement uncertainty. If the measurement uncertainty is considered to be negligible for some purpose, the measurement result may be expressed as a single measured quantity value. In many fields, this is the common way of expressing a measurement result.

[SOURCE: ISO/IEC Guide 99:2007, 2.9, modified – Notes 1 and 3 to entry have been deleted.]

3.1.11
measurement accuracy
closeness of agreement between a measured quantity value and a true quantity value of a measurand

Note 1 to entry: The concept "measurement accuracy" is not a quantity and is not given a numerical quantity value. A measurement is said to be more accurate when it offers a smaller measurement error.

[SOURCE: ISO/IEC Guide 99, 2.13, modified – Note 2 and 3 to entry have been deleted.]

3.1.12
measurement standard
standardized measurement procedure
normative document established by consensus and approved by a recognized body, that provides a measurement procedure, for common and repeated use, aimed at the achievement of the optimum degree of order in a given context

Note 1 to entry: Standards are in general based on the consolidated results of science, technology and experience, and aimed at the promotion of optimum community benefits.