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TECHNICAL SPECIFICATION

Nanomanufacturing - Product specification -
Part 2-1: Carbon nanotube-related products - Blank detail specification: single-walled carbon nanotubes in powders and dispersions

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Nanomanufacturing - Product specification - Part 2-1: Carbon nanotube-related products - Blank detail specification: single-walled carbon nanotubes in powders and dispersions

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IEC TS 62565-2-1 has been prepared by IEC technical committee 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
113/941/DTS	113/965/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 specification*, 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,

– withdrawn, or

– revised.

INTRODUCTION

This document is intended to provide guidance on how to list, illustrate and define various characteristics of single-wall carbon nanotubes (SWCNTs) for use in electrotechnical products, and how to incorporate these into a bilateral detail specification between vendor and user. A particular point of interest is the fact that there are many different types (diameter, chirality) of SWCNTs and various treatments for chemical modification have been developed. Subtle differences in the physical structure give rise to marked differences in electrical, optical and chemical properties; therefore it is important to pay these characteristics special attention.

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

To facilitate a reliable source of carbon nanotubes with tailored properties (length, diameter, purity, chirality, conduction type), it is important to specify the characteristics in a standardized way, stating the specification limits and the characterization methods to prove conformance.

Accurately measuring and assessing the quality of nanotube-containing materials and the dispersion of nanotubes in liquids or polymers, are both considered crucial for the continued growth of applications incorporating single-wall carbon nanotubes. Although a range of SWCNT powders and dispersions are commercially available, the specifications for these products vary significantly. Some suppliers provide specifications of many parameters along with the methods of measurement used while others only report a minimal set of numbers with no indication of how these were measured. For this reason, comparison and specification of the quality of CNT materials is extremely difficult. While much progress in development of SWCNT characterization measurements has been made [1] [2] [3][1], significant improvements are still crucial to assess the quality of carbon nanotube-containing materials and the protocol for doing so (e.g. how to describe the characteristics relevant for the quality of the final nano-enabled products).

In addition to providing guidance for materials suppliers and users for how to draft bilateral procurement contracts, this BDS can also serve as a roadmap for the future development of KCC measurement standards for SWCNTs.

[1] Numbers in square brackets refer to the Bibliography.

1 Scope

This part of IEC 62565 establishes a blank detail specification and format for listing the relevant key control characteristics (KCCs) of single-wall carbon nanotubes (SWCNTs). This document is intended to be used for SWCNTs in the form of powders and dispersions.

For each KCC listed, methods and existing standards (in cases where they are applicable) for their measurement are indicated. Numeric values to be specified for the properties and characteristics are intentionally left blank and are determined by agreement between customer and supplier. Properties and characteristics not of relevance for a specific application can be classified as not applicable or not specified.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

– IEC Electropedia: available at https://www.electropedia.org/

– ISO Online browsing platform: available at https://www.iso.org/obp

3.1
key control characteristic
KCC
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 (see 3.2).

3.2
blank detail specification
BDS
structured generic specification providing a comprehensive set of key control characteristics which are necessary to describe a specific nano-enabled product without assigning specific values 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.

3.3
chirality
vector notation used to describe the structure of a single-wall carbon nanotube (SWCNT)

Note 1 to entry: A SWCNT can be viewed as a cylinder rolled up from a single-atom-layer thick graphene sheet, where the rolling direction is denoted by the chiral vector $C = na_1 + ma_2$

[SOURCE: ISO/TS 10867:2019 [4], 3.1, modified – Note 1 to entry has been added.]