



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

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**Nanotechnologies - Test methods for measurement of electrical
properties of carbon nanotubes**

纳米技术 碳纳米管电学特性测试方法

(English Translation)

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Foreword

This document is in accordance with the provisions of GB/T 1.1-2020 "Guidelines for standardization work Part 1: Structure and drafting rules for standardization documents" Drafting.

This document is modified to adopt IEC 62624:2009 "Test methods for electrical properties of carbon nanotubes".

This document has made the following structural adjustments compared to IEC 62624:2009.

- Chapter 1 corresponds to 1.1 of IEC 62624:2009;
- Added Chapter 2 normative references;
- Chapter 3 corresponds to Chapter 2 of IEC 62624:2009;
- Chapter 4 corresponds to 1.3 of IEC 62624:2009, of which 4.5.3 corresponds to 1.3.5.2 and 1.3.5.3 of IEC 62624:2009;
- Chapter 5 corresponds to Chapter 3 of IEC 62624:2009;
- Chapter 6 corresponds to Chapter 4 of IEC 62624:2009;
- Chapter 7 corresponds to 5.1, 5.2 and 5.3.1 of IEC 62624:2009;
- Chapter 8 corresponds to 5.3.2 and 5.4 of IEC 62624:2009, and 8.5 corresponds to 5.3.2.5 and 5.4 of IEC 62624:2009;
- References correspond to Appendix A in IEC 62624:2009.

The technical differences between this document and IEC 62624:2009 and their reasons are as follows.

- Deleted the "Purpose" in 1.2 of IEC 62624:2009 to comply with the provisions of GB/T 1.1-2020;
- Change the second sentence of the introduction in 2.1 of IEC 62624:2009 to a note (see 3.1) to comply with GB/T 1.1-2020 Provisions;
- Changed the definition of "carbon nanotube" (see 3.1.1) to use the latest definition;
- The terms "excitation end", "excitation voltage", "ground platform", "Kelvin measurement", "multi-walled carbon nanotubes", "measurement end", "single-walled

carbon nanotubes" or "transfer properties", as these terms are not used or are used only once in this document;

--- The abbreviation "NIST" has been deleted because it is not used in this document;

--- Added the abbreviations "EMI" and "RFI" because these two abbreviations are used in 4.6 of this document (see 3.2);

--- Change "100aA (10-16A)" to "1fA (10-15A)" to conform to the logic of the previous statement (see 4.1);

--- Deleted "National Institute of Standards and Technology (NIST)" to increase operability and improve the applicability of this document (see 4.1);

--- Change "Introduction the purpose of this document is to provide recommended methods and reporting requirements for the characterization of electrical properties of carbon nanotubes (CNTs).

If the operation is not done properly, large measurement errors will be introduced. This document describes the common sources of measurement errors, especially in the measurement of electrical properties of carbon nanotubes.

The high impedance test commonly used in the measurement is introduced, and the recommended operation method is given to reduce the impact caused by different measurement methods.

Development of these methods will help to establish a recommended report that can be used from research to manufacturing.

In order to standardize the analytical report data, this document also provides reporting requirements, including descriptions of environmental conditions and sample size, so that researchers can these reporting requirements also support the reproducibility of results so that new findings can be more effectively confirmed.

This document aims to promote the development of carbon nanotube technology from the laboratory to industry. Standardized characterization methods and reporting requirements provide information it provides a means for efficiency comparison and lays the foundation for production and manufacturing.

Nanotechnology Carbon Nanotube Electrical Properties Test Method

1 Scope

This document describes the test methods for the electrical properties of carbon nanotubes.

This document is applicable to the measurement of electrical properties of carbon nanotubes prepared by different process routes.

2 Normative references

This document has no normative references.

3.1 Terms and Definitions

The following terms and definitions apply to this document.

Note: For terms not defined in this clause, refer to IEEE100.

3.1.1

Carbon nanotube

Nanotubes made of carbon atoms.

Note: It is usually composed of a curled carbon monolayer, including single-walled carbon nanotubes, double-walled carbon nanotubes and multi-walled carbon nanotubes.

[Source. GB/T 30544.3-2015, 4.3] 3.1.2 Chirality the property of a molecule that its structure cannot be superimposed on its mirror image.

3.1.3

Device under test

A sample that is connected to an instrument for evaluating a specific physical property, such as resistance or IV characteristics.

3.1.4

The real or artificial atmospheric conditions immediately surrounding the device under test.

Note: The measurements should be made as close to the device under test as possible and in a manner that minimizes the impact on the test environment.

3.2 Abbreviations

The following abbreviations apply to this document.

AC. alternating current CNT. Carbon nanotube DC. Direct current DUT. Device under test