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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

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Nanotechnologies - Characterization of multiwall carbon nanotubes - Mesoscopic shape factors

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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 of Standardization Documents"

Drafting.

This document uses the translation method equivalent to ISO /T S11888.2017 "Nanotechnology Characterization of Multi-walled Carbon Nanotubes Mesoscopic Shape

factor".

The following editorial changes have been made to this document.

---In 5.2, the definition of inner diameter and outer diameter was added in the form of "note";

---In Figure 1c), a high-resolution image of a transmission electron microscope with a scale of 5nm has been added;

---Delete "Note. Source..2010ACS" in ISO /T S11888-2017 Figure 1, Figure D.1, Figure D.3, and Figure D.4, because it is unclear

And did not give specific available information.

Introduction

Multi-walled carbon nanotubes (MWCNTs) prepared by chemical vapor deposition (CVD) can be used for polymer composites, conductive coatings, etc.

Industry. In most cases, MWCNTs prepared by CVD have static (persistent) bending points randomly distributed along the axial direction.

The physical and chemical properties of MWCNTs products mainly depend on the mesoscopic of the single MWCNTs (see ISO /T S80004-3) that make up the product

Shape and size[4][6], so in the face of health, environment and safety (EHS) issues and in the field of materials such as composite materials or other dispersion systems

When widely used, the characterization of the mesoscopic shape of MWCNTs is the key to the reproducible final performance.

This document gives the mesoscopic form factor characterization method of MWCNTs, including sample preparation procedures. In particular, this document provides

A statistical method is used to characterize MWCNTs prepared by CVD. During the preparation of MWCNTs, the axial structure is not perfect

It is linear, but includes static bending points.

This document provides a method to determine the statistic "Static Bending Duration (SBPL)". SBPL means no deformation due to permanent bending

The maximum straight line length, which gives the relationship between the mesoscopic shape and size of MWCNTs. If two MWCNTs have the same length but

If SBPL is different, its overall dimensions (such as equivalent diameters such as radius of gyration, hydrodynamic diameter, etc.) will also be different. In actual application, SBPL's

Differences will affect the chemical reactivity and physical properties of MWCNTs [4-6].

The conductivity and dimensional stability of MWCNTs-polymer composites are closely related to the SBPL value of MWCNTs [4-6]. SBPL value

It can affect the electroosmotic flow threshold [6] [8], toxicity [7], thermal conductivity [9], rheological properties [10] and field emission performance [11] and many other properties. SBPL available

In order to estimate the load of MWCNTs-polymer matrix that reaches the conductivity (percolation limit), and help to simulate MWCNTs-polymer complex

The mechanical properties of the composite material change with the doping amount of carbon nanotubes.

Before starting work related to carbon nanotubes, it is recommended to learn more about

the handling and disposal methods of carbon nanotubes, and pay attention to personal

Protection.

Nanotechnology Characterization of Multi-walled Carbon Nanotubes

Mesoscopic form factor

1 Scope

This document describes the method for characterizing the mesoscopic shape factor of multi-walled carbon nanotubes (MWCNTs). The characterization techniques used include scanning

Electron microscopy (SEM), transmission electron microscopy (TEM), viscosity method and light scattering method, etc.

This document also includes additional clauses for defining the characterization of the static bending duration (SBPL), which gives the measurement used to evaluate the SBPL

Method, its length is usually between tens of nanometers to hundreds of microns.

This document draws on concepts and mathematical expressions from polymer physics to define the mesoscopic form factor of MWCNTs.

2 Normative references

There are no normative references in this document.

3.1 Terms and definitions

The following terms and definitions apply to this document.

The terms and definitions used in this document in ISO and IEC can be found on the following website.

Note. See Appendix A for the expressions of some terms and definitions.

3.1.1

Mesoscopic shape

In the observation scale, the description of the shape of a single MWCNTs.

Note 1.Mesoscopic shape factor describes the average size and shape of a single MWCNTs, while "macro" describes the aggregates or aggregates of MWCNTs

Shape and size. "Atomic-scale resolution" describes the shape of a single MWCNTs at the atomic level (see Figure 1).

Note 2.See reference [4].

a) Macro (aggregate) b) Mesoscopic (single root)

Figure 1 The shape of MWCNTs at different observation scales