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**Nanotechnologies - Measurements of particle size and shape
distributions by scanning electron microscopy**

纳米技术 扫描电子显微术测量纳米颗粒粒度及形状分布

(English Translation)

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Reference

Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part 1: Structure and Drafting Rules of Standardization Documents" Drafting.

This document is equivalent to ISO 19749:2021 "Nanotechnology Scanning Electron Microscopy for Measurement of Nanoparticle Size and Shape Distribution".

This document has made the following minimal editorial changes.

---Change the reference to particle number in 3.4.10 to 3.1.3;

---Change the references to convex hull numbers in 3.4.11 and 3.4.14 to 3.4.6;

---The overall title of Figure 6 is "8013 Colloidal Gold Particles", while the sub-titles of Figure 6 are "8011 Colloidal Gold Particles" and "8012" Colloidal Gold Particles Particles, this article will hide the brand-related information in the general table title and change it to the corresponding nominal size particles;

---When there are no parallel items in the comments, change Note 1 to Note.

Please note that some content in this document may involve patents. The publisher of this

document assumes no responsibility for identifying patents.

Introduction

Provide guidance on measuring shape distribution and issuing test reports. This document is also applicable to SEM-based measurements of larger particles. Particles are three-dimensional (3D) structural objects, and SEM images present the two-dimensional (2D) information of this 3D information at a specific angle, including Contains useful information on particle size and shape. Strictly speaking, the 3D characteristics of nanoparticles include particle size, shape, surface structure (such as texture), Surface and internal material components and their distribution. Although SEM images actually contain certain 3D information, for the sake of simplicity, this document this part is not covered. This paper focuses on discrete and agglomerated nanoscale objects (materials that are nanoscale in at least one dimension, i.e. 1nm~ 100nm) two morphological characteristics. particle size and shape. In order to obtain high-quality electron microscopy images, it is necessary to use the appropriate sample Preparation method, the preparation method depends on the specific materials. In addition, measurement uncertainty requirements are equally important for SEM testing. general refers to in order to obtain statistically significant particle size and shape distribution, it is recommended that the number of measured particles should be from hundreds to thousands. Measurement of actual nanoparticles , the number of measured particles depends on the sample, uncertainty requirements and SEM performance. The test report contains statistical analysis of the data and and measurement uncertainty analysis.

This document includes chapters on measurement procedures, particle analysis, data analysis, and reporting. Guidance examples of measurements are given in the appendix to achieve Reliable quantitative measurements with SEM. Automation of image acquisition and data analysis can reduce costs and improve the quality of results. Typically, discrete nano it is more convenient to use automatic image acquisition and particle analysis systems for rice particle samples; for complex discrete nanoparticles and nanoparticle aggregates or the measurement of agglomerates requires the operator's assistance in image acquisition and analysis. Appropriately use some analysis software to analyze the shapes of various types of particles.

Automatic screening also helps to evaluate particle shape.

Nanotechnology scanning electron microscopy measuring nanoparticles Particle size and shape distribution

1 Scope

This document specifies the determination of nanoparticle size and Shape distribution method.

Note 1: The lower limit of particle size measurement applicable to this document depends on the SEM performance and measurement uncertainty requirements. The relevant information is based on the requirements described in this document.

Prove it.

Note 2: This document is also applicable to the measurement of particle size and shape distribution of particles larger than nanometer scale based on SEM image method.

2 Normative reference documents

The contents of the following documents constitute essential provisions of this document through normative references in the text. Among them, the dated quotations for undated referenced documents, only the version corresponding to that date applies to this document; for undated referenced documents, the latest version (including all amendments) applies to this document.

ISO/IEC Guide 99:2007 Basic general concepts and related terminology of international terminology in metrology (VIM) [Internationalvo-Note. GB/T 15445.1-2008 Representation of particle size analysis results Part 1: Graphical representation (ISO 9276-1:1998, IDT) ISO 9276-2 Representation of particle size analysis results Part 2: Calculation of mean particle size/diameter and individual moments (Repre-Note. GB/T 15445.2-2006 Expression of particle size analysis results Part 2: Calculation of average particle size/diameter and individual moments from particle size distribution (ISO 9276-2:2001, IDT) ISO 9276-3 Representation of particle size analysis results Part 3: Adjustment of experimental curves to reference models (Representationofre-ISO 9276-5 Expression of particle size analysis results Part 5: Calculation method for particle size analysis using lognormal probability distribution Note. GB/T 15445.5-2011 Expression of particle size analysis results Part 5: Calculation method for particle size analysis using lognormal probability distribution (ISO 9276-5:2005, IDT) ISO 9276-6 Representation of particle size analysis results Part 6: Qualitative and quantitative representation of particle shape and morphology (Representation of phology) Note. GB/T 15445.6-2014 Expression of particle size analysis results Part 6: Qualitative and quantitative expression of particle shape and morphology (ISO 9276-6. 2008, IDT)

Note: GB/T 21649.1-2008 Particle size analysis image analysis method Part 1: Static image analysis method (ISO 13322-1:2004, MOD)