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

GB/Z 44005.1-2024

**Nanotechnologies - Clay nanomaterials - Part 1: Specification of
characteristics and measurement methods for layered clay
nanomaterials**

纳米技术 黏土纳米材料 第1部分：层状黏土的特性及测量方法

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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 part 1 of GB/T 44005 Nanotechnology Clay Nanomaterials: GB/T 44005 has been published for the following part:

--- Part 1: Characteristics and measurement methods of layered clays: This document is modified to adopt ISO /T S21236-1:2019 "Nanotechnology clay nanomaterials Part 1: Characteristics and The document type was adjusted from ISO technical specification to my country's national standardization guidance technical document: The technical differences between this document and ISO /T S21236-1:2019 and their reasons are as follows:

---Replace the terms "loose density", "clay" and "vibrated density" in ISO /T S21236-1:2019 with the existing term definitions in my country's standards: The definition of "degree" (see 3:2, 3:4, 3:22): The following editorial changes were made to this document:

--- GB/T 31057:1-2014 and GB/T 31057:2-2018 replaced the informative references to the Japanese Pharmacopoeia (JP) and the European Pharmacopoeia to adapt to my country's technological development (see 5:4:6);

--- GB/T 22879-2008 and GB/T 40277-2021 replace the informative references TAPPIT646 and TAPPIT452, to adapt to my country's technological development (see 5:4:11);

--- GB/T 7702:6-2008 replaced the informative reference ASTM C837-09 (2014) to adapt to the technological development of my country (See 5:4:13):

---Adjusted references: Please note that some of the contents of this document may involve patents: The issuing organization of this document does not assume the responsibility for identifying patents: This document was proposed by the Chinese Academy of Sciences: This document is under the jurisdiction of the National Nanotechnology Standardization Technical Committee (SAC/TC279): This document was drafted by: Xuchang University,

Institute of Basic Medicine, Chinese Academy of Medical Sciences, National Center for Nanoscience and Technology, Zaozhuang University, Xuchang Municipal Quality and Technical Supervision Inspection and Testing Center: The main drafters of this document are: He Weiwei, Yang Qi, Wen Tao, Zhang Yahong, Xu Haiyan, Wu Xiaochun, Ji Yinglu, Zheng Zhi, Liu Jianbo, Fa Wenjun, Guo Zhiyong, Tan Yibing, and Li Dapeng:

Clay refers to a natural or synthetic material composed mainly of fine-grained minerals that exhibits plasticity over a range of water contents and that forms a uniform structure after firing: The minerals in clay are generally silicates with a lateral size of less than 2 μm : Clay is very abundant on the earth's surface: The rocks they form are called shales, which are the main components of almost all sedimentary rocks: The small size of the particles and the unique crystal structure give clay materials Some special properties include cation exchange capacity, plasticity when wetted, catalytic activity, swelling and low permeability[18]: Clay materials are a type of clay material whose external dimensions (thickness) or internal structural dimensions (interlayer spacing) are at the nanoscale: In addition to structure and composition, other important factors that determine the properties and applications of clay and clay nanomaterials are listed in Appendix A: These factors include The types, quantities and forms of mineral impurities, organic materials, exchangeable ions and soluble salts are included [2]: Clay is a very important industrial material: In its original state, clay materials are usually sub-nano layered structures, in bundles and exfoliated states: For intercalated clays, they are structured nanomaterials with nanometer-scale thickness and interlayer spacing: spacing, exchangeable ions and surface groups, which can expand its application in high-performance nanocomposites, effective rheology modifiers or biomedical applications: It has been shown that small amounts of intercalated or exfoliated organically modified layered clay nanomaterials dispersed in polymer composites can (See Appendix B) It has a significant impact on barrier properties, tensile modulus, mechanical strength and flame retardancy: Layered clay nanomaterials have many industrial applications: Industrial applications: purified and modified clay can be used in paper coatings to improve whiteness and have suitable ink absorption, tire rubber life extenders, Concrete and many industrial production catalysts: Due to its good cation exchange capacity, low permeability and long-term structural stability, it can also Used in oil purification, pharmaceuticals, ceramic industry, soil stabilization, porcelain, nuclear waste and chemical waste barriers: In addition, layered clay nanomaterials are also used Used in purification industry, agriculture and food engineering, polymer nanocomposites, deodorants, insecticide carriers, pesticide carriers, drilling fluids, desiccants, cleaning agents, Detergents, plasticizers, emulsion stabilizers, food additives, cosmetic applications and environmental remediation and other fields[18][19]: In the application of clay nanomaterials, their basic properties (as shown in Table 1) play an important role: These properties are determined by the layered clay nanomaterials: In fact, the determination of these basic characteristics will help the communication between the supply and demand sides: These characteristics apply to all In addition to the basic properties listed in Table 1,

the application of layered clay nanomaterials in the industry is also very promising, such as nanocomposites, paper, inks, purification and catalysts: In addition, other optional properties of layered clay nanomaterials are listed in Table 2, which are measured and reported based on the agreement between the supplier and the buyer: GB/T 44005 "Nanotechnology Clay Nanomaterials" is planned to consist of two parts:

--- Part 1: Properties and measurement methods of layered clay: The purpose is to provide terms and definitions related to layered clay nanomaterials, To accurately and standardize the analysis and characterization of the properties of layered clay nanomaterials, allowing comparison and evaluation of test results from different institutions:

--- Part 2: Characteristics and measurement methods of clay nanosheets for gas barrier films: The purpose is to give The relevant terms and definitions of the gas barrier film are clarified and standardized, and the analysis and characterization of clay nanosheets for gas barrier films are allowed to be tested by different institutions: Make comparisons and evaluations: Nanotechnology Clay Nanomaterials Part 1: Properties and measurement methods of layered clays

1 Scope

GB/Z 44005.1-2024 characterises layered clay nanomaterials. Clays are the oldest nanomaterials in industrial use and among the least standardised: montmorillonite and its relatives are naturally occurring stacks of sheets roughly a nanometre thick, and dispersing those sheets into a polymer at a few percent loading raises stiffness and barrier properties substantially. Whether that works depends on properties the supplier's datasheet usually does not state - the cation exchange capacity, the spacing between layers, the surface modification chemistry that makes a hydrophilic clay compatible with a hydrophobic polymer, and the degree to which the stacks actually separate rather than remaining as agglomerates. Two clays sold under the same description can behave entirely differently, and the buyer discovers it in the compound. This part presents the properties of powdered and chemically modified layered clay nanomaterials and describes the corresponding measurement methods. It does not address health, safety or environmental issues, which are treated separately. As a GB/Z it is a guiding technical document. Under ICS 07.120 and CCS L04, it is written for clay suppliers, nanocomposite formulators and the analytical laboratories serving them.

This document presents the properties of powdered and chemically modified layered clay nanomaterials and describes the relevant measurement methods: This document does not address the health, safety and environmental issues of clay nanomaterials:

2 Normative references

This document has no normative references:

3 Terms and definitions

The following terms and definitions apply to this document: 3:1 aspect ratio The ratio of lateral dimension to thickness: [Source: ISO 8336:2017, 3:13] 3:

2 Bulk density The mass of a unit volume naturally filled by granular material under specified conditions: [Source: GB/T 31057:1-2014, 3:1] 3:

3 The amount of exchangeable cations per unit mass of clay nanomaterial sample: 3:

4 Clay A natural fine-grained mineral aggregate that is mainly composed of clay minerals and contains some non-clay minerals or organic matter and is plastic when mixed with water: Fusion:

Note 1: See reference [20] for details:

Note 2: Clays usually contain layered silicates and may also contain other types of materials that have plasticity and drying/firing hardening properties: It can contain non-plastic materials and organic matter: Different disciplines have unique definitions of the size of clay particles, and the term "fine particles" is used in the definition: Rather than an exact value: Since these dimensions vary from discipline to discipline, it is important to give the particle size in the application: [Source: GB/T 5000-2018, 3:4, modified] 3:

5 Clay nanomaterials Clay materials with nanoscale external dimensions or internal structures: 3:

6 Exchangeable ion Ions in clay that are exchanged for other ions: