

ICS 77.040.10

CCS H 22



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

GB/T 21838.4-2020

Replacing GB/T 21838.4-2008

**Metallic materials. Instrumented indentation test for hardness
and materials parameters - Part 4: Test method for metallic and
non-metallic coatings**

Issued on: December 14, 2020

Implemented on: July 1, 2021

**Issued by: State Administration for Market Regulation, China National
Standardization Administration**

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Foreword

This document is in accordance with the provisions of GB/T 1:1-2020 Standardization Guidelines Part 1: Structure and Drafting Rules of Standardization Documents

Drafting:

GB/T 21838 "Instrumental indentation test of hardness and material parameters of metallic materials" is divided into 4 parts:

---Part 1: Test method;

---Part 2: Inspection and calibration of the testing machine;

---Part 3: Calibration of standard blocks;

--- Part 4: Test methods for metallic and non-metallic coatings:

This document is Part 4 of GB/T 21838:

This document replaces GB/T 21838:4-2008 "Instrumented indentation test for hardness and material parameters of metallic materials-Part 4: Gold

Compared with GB/T 21838:4-2008, the main technical changes are as follows:

- Delete some symbols and instructions (see Chapter 3 of the:2008 edition);
- Deleted the flow chart of countermeasures when indirect inspection fails (see Figure 1 in the:2008 edition);
- Deleted the description of drift rate measurement (see 6:2:2 of the:2008 edition);
- Modified the determination of the cover layer into the modulus (see 7:2, 7:2 of the:2008 edition);
- Modified the determination of the overlay hardness (see 7:3, 7:3 of the:2008 edition);
- Added the description of uncertainty estimation (see Chapter 8);
- Deleted the normative appendix frame flexibility calibration procedures (see Appendix A of the:2008 edition):

The translation method used in this document is equivalent to ISO 14577-4:2016

``Instrumental indentation test for hardness and material parameters of metallic materials

Part 4: Test methods for metallic and non-metallic coatings":

The Chinese documents that have consistent correspondence with the international documents cited in this document are as follows:

---GB/T 27418-2017 Measurement Uncertainty Evaluation and Expression (ISO /IEC Guide 98-3:2008, MOD):

This document has made the following editorial changes:

- Add a footnote to Table 1: "For non-circular indentations, a is the equivalent radius of the contact area" (see Chapter 3);
- Modify "cone = spherical > Vickers > Bosch" to "a cone = a sphere > a Vickers > a Bosch (the subscript indicates the shape of the indenter)" (see

7:1):

Please note that certain contents of this document may involve patents: The issuing agency of this document is not responsible for identifying patents:

This document was proposed by the China Iron and Steel Association:

This document is under the jurisdiction of the National Steel Standardization Technical

Committee (SAC/TC183):

Drafting organizations of this document: Shanghai Materials Research Institute, ZF Asia Pacific Group Co., Ltd., Dongguan Materials Gene Advanced Institute of Science and Technology, Metallurgy

Industrial Information Standards Research Institute, Steel Research Nac Chengdu Testing and Certification Co., Ltd:

Introduction

The elasticity and plastic properties of the covering layer are important indicators to determine the quality of the covering layer: In fact, adding a covering layer on the surface of many products can be

In order to improve its wear resistance, high hardness is usually a prerequisite for improving wear resistance: The measurement of coating hardness is often used as a quality control tool

segment: Young's modulus is very important for the stress calculation in the cover layer composition design: For example, the ability of the cover layer to resist external forces is one of the parts of the cover layer:

An important feature:

The instrumented indentation test can be used to determine the hardness and indentation modulus of bulk materials relatively easily: However, when entering the surface of the cover

When performing the indentation test, the performance of the base material has an influence on the test results, and the degree of influence depends on the test force, the nature and thickness of the covering layer:

The purpose of the method proposed in this document is to provide possible analysis methods in the case that the matrix significantly affects the measurement

The performance of the covering layer is obtained in the composite measurement of the layer: Sometimes, the performance of the cover layer can also be directly obtained by measuring its cross section:

Metal material hardness and material parameters

Instrumented indentation test Part 4:

Test methods for metallic and non-metallic coatings

1 Scope

This document specifies the instrumented indentation test method for the hardness and

material parameters of metallic and non-metallic coatings: It is particularly suitable for nano/display

Thin coating test in the micro range: If the indentation depth is so small relative to the thickness of the cover layer that it can be ignored under any possible circumstances

When the cover layer is regarded as a bulk material due to the influence of the base material, it is not necessary to adopt this document: The test restriction conditions in this case will be

The file is given:

This method is limited to the single-layer overlay test with vertical indentation on the surface of the sample, but if relative to the size of the indentation, the

If the thickness or gradient is greater than the measurement resolution, the properties of materials with gradients and multilayer coatings can also be measured on its cross section:

This method does not limit the type of material, it is suitable for metal and non-metal covering layers: In this document, the term "overlay" is used to describe

Connect any solid layers with different substrates and uniform properties: This method assumes that the performance of the overlay does not change with the indentation depth: For composite materials

If the microstructure size is smaller than the indentation size, the composite cover can be regarded as uniform:

This document only applies to the use of a pyramid or conical indenter with a sufficiently small radius of curvature at the tip to ensure the plastic deformation caused by the measurement:

Born inside the cover: For viscoelastic or creep-prone materials, the test time has a great influence on the hardness measurement:

Note 1: ISO 14577-1, ISO 14577-2 and ISO 14577-3 specify the instrumented indentation test method for bulk materials in all force and displacement ranges:

Note 2: The analysis used here does not consider the pile-up or sink-in of the indentation: Use atomic force microscope (AFM) to evaluate the shape of indentation

In order to determine the bumps or depressions on the surface around the indentation, these surface effects cause the underestimation (protrusion) or overestimation (depression) of the contact area in the analysis, and then the

Can affect the measurement results: Bumping usually occurs on fully work hardened materials: Due to the constraint of stress in the plastic deformation zone of the covering layer, the soft extension