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

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General rules for the instrumented nanoindentation test

仪器化纳米压入试验方法通则

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Foreword

This standard Annex A, Annex B, Appendix E, Appendix F, Appendix I of normative appendix, Appendix C, Appendix D, Appendix G, Appendix H to Informative appendix. Please note that some of the content of this standard may involve patents. The standard release mechanism should not bear the responsibility to identify these patents. This standard by the National Standardization Technical Committee of nano technology (SAC/TC279) and focal points. This standard was drafted. Baoshan Co., Mechanics Institute of Iron and Steel. The main drafters of this standard. Xiu-Fang Wang, Zhang Taihua, Song Hongwei, Yang Xiaoping, Yang Rong, Huan Yong.

Restrictions optical microscope resolving power by conventional hardness test methods can not extend to the nanometer scale, based on the depth of measuring instruments Of the nanoindentation technique emerged. The technology in terms of scale, the principles and parameters measured have undergone significant changes, mainly reflected in.

--- With real-time measurement and depth of the press-fit load replace residual indentation diagonal measurement of nano-scale to achieve a measure of operating and Automation process;

--- Mechanics by establishing an appropriate model, you can get a variety of hardness and material parameters, such as pressed into modulus;

--- Can study the mechanical response of materials throughout the loading and unloading process. In recent years, the rapid domestic nano-indentation test technology development, is becoming the most important means of nanomechanical characterization test field. However And, using this technology affect the test, vulnerable equipment, environment, methods, sample and test personnel, and many other factors, which often leads to results Comparability difference. Therefore an urgent need to regulate the instruments through standardized nano indentation test methods. In 2002, ISO 14577-1.2002 "instrument metal

hardness and materials parameters indentation test - Part 1. Test method Law ", ISO 14577-2.2002" instrument metal hardness and materials parameters indentation test - Part 2. testing machines and school Associate ", ISO 14577-3.2002" instrument metal hardness and materials parameters indentation test - Part 3. Calibration of reference blocks "(English Chinese Version) released. In 2007, ASTM E2546-07 "Instrumented indentation test procedures" release. The standard of written reference to the above criteria Applicable sections, taking into account the future development trend of technology, two new appendices. Since the major domestic use nanoindentation instrument into Instrumented indentation test line, therefore, the scope of this standard within the limits of such use of the instrument. Instrumented nanoindentation General test method

1 Scope

China's national general rules for instrumented nanoindentation. It specifies the basic method, the requirements on the test equipment and its capability, the calibration and verification of the instrument, the indenter and the reference specimens, the determination of the instrument compliance and the indenter area function, the data analysis needed to determine hardness and the material parameters, and the precautions in using the indenter. Conventional hardness testing presses an indenter into a surface, removes it, and measures the impression that remains. At the nanometre scale that cannot be done: the impression is too small to measure reliably, and much of the deformation is elastic and disappears when the load is removed. Instrumented indentation solves it by measuring continuously instead - recording load and displacement throughout both the loading and the unloading, and deriving the properties from the curve rather than from the residual mark. That gives hardness and, from the slope of the unloading curve, the elastic modulus as well, from a volume less than a micrometre across. It is how a thin film, a coating, an ion-implanted layer, a single phase in an alloy or an individual grain is measured at all. The difficulty is that at this scale the instrument is part of the measurement. The machine's own compliance is comparable to the specimen's, so it has to be determined and subtracted. The indenter is never perfectly sharp, so its area as a function of depth has to be calibrated rather than assumed from geometry. Thermal drift during a measurement lasting a minute displaces the tip by more than the depth being measured. And surface roughness, contamination and the substrate beneath a thin film all bias the result. The standard is written around exactly those. Issued on 29 October 2008 and in force since 1 May 2009.

This standard specifies the basic method of instrumented nanoindentation test equipment and test capacity requirements, but also provides for instrument calibration And testing, indenter, standard sample requirements, and to determine the method of instrument compliance and indenter area function, and given to determine the hardness and material parameters The required number of data analysis methods and precautions indenter used. This standard applies to test a variety of materials and hardness, modulus film, indentation depth typically ranges from nanometers to be expanded Exhibition to several micrometers.

2 Normative references

The following documents contain provisions which, through reference in this standard and become the standard terms. For dated references, subsequent Amendments (not including errata content) or revisions do not apply to this standard, however, encourage the parties to the agreement are based on research Whether the latest versions of these documents. For undated reference documents, the latest versions apply to this standard. General principles

GB/T 15000.3 standard for the work of (3) standard sample set values and statistical methods

GB/T 13634-2000 testing machines dynamometer calibration (ISO 376.1999, IDT)

JB/T 7522-2004 Nondestructive Testing Materials ultrasonic velocity measurement

JJF1059-1999 Evaluation and Expression of Uncertainty in Measurement (ISO GUM.1995, IDT)

3 Terms and definitions, symbols

3.1 Terms and Definitions The following terms and definitions apply to this standard.

3.1.1 Load curve and depth between the indenter resulting indentation is applied to it from loading - unloading cycle in the collection The data, shown in Figure 1.

3.1.2 Contacting the sample with the indenter instantaneous elastic response, showing ability of the material to resist deformation by the load - depth curve unload part The slope of the tangent at the maximum load is determined.

3.1.3 Shows a modified chassis, actuators, indenter, the sample table, anvil, etc. in the press-fit loading, it is applied to the load on the specimen Lead.

3.1.4 Indenter tip along the centerline of the projected area (cross-sectional area) and the pressure head points to a function of the distance between the cross-section.

3.1.4.1 Calculated in accordance with the designed shape of the indenter area function obtained.

3.1.4.2 Appendix A use indirect methods to determine the function of the area.