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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 42543-2023

Surface chemical analysis - Scanning probe microscopy - Determination of cantilever normal spring constants

表面化学分析 扫描探针显微术 悬臂梁法向弹性常数的测定

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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 equivalent to ISO 11775:2015 "Surface Chemical Analysis Scanning Probe Microscopy Determination of Normal Elastic Constant of Cantilever Beam" Certainly": The Chinese documents that have consistent correspondence with the international documents cited in this document are as follows:

--- GB/T 22461:2-2023 Surface Chemical Analysis Vocabulary Part 2: Scanning Probe Microscopy Terminology (ISO 18115-2: 2013, IDT) This document was proposed and managed by the National Microbeam Analysis Standardization Technical Committee (SAC/TC38): This document is drafted by: Shanghai Jiaotong University, Shanghai Institute of Applied Physics, Chinese Academy of Sciences, Shanghai Institute of Metrology and Testing Technology, Rice Technology and Application National Engineering Research Center: The main drafters of this document: Sun Jielin, Shen Yi, Hu Jun, Li Yuan, Cai Xiaoyu, He Dannong:

Atomic Force Microscopy (AFM) is a mode of Scanning Probe Microscopy (SPM), in which a sharp probe tip on a flexible cantilever beam is placed on the sample surface The force between the probe and the surface is sensed during mechanical scanning, which causes the deflection of the cantilever beam, and the sample surface is formed by monitoring the deflection amount: picture: Depending on the measurement mode and probe performance, this method can obtain information on the morphology, mechanics, chemistry, and electromagnetics of the sample surface: according to: From measuring the dissociation forces between proteins and other molecules to determining the elastic modulus of materials (e:g: surfaces with organics and polymers) Various fields of application require

precise mechanical measurements: In this type of mechanical measurement, the value of the normal elastic constant (kz) of the AFM cantilever is must be known: The kz value given by the probe cantilever manufacturer may have an error of up to three times, so a practical method standard is needed: Set kz: This document describes three categories of the five simplest methods for determining the normal elastic constant of an AFM cantilever: These methods are It belongs to one of the three categories of dimension method, static experiment method and dynamic experiment method: The choice of method depends on the purpose and ease of analysis: Many other methods can also be found in the literature: Surface Chemical Analysis Scanning Probe Microscopy Determination of Normal Elastic Constant of Cantilever Beam

1 Scope

GB/T 42543-2023 gives the determination of the normal spring constant of an atomic force microscope cantilever, equivalent to ISO 11775. Every force an AFM reports is the product of a measured deflection and this constant, and the value printed on the box by the manufacturer can be out by a factor of two, because the constant goes as the cube of a thickness that varies across the wafer. Any quantitative nanomechanics therefore begins by measuring it. The standard sets the background and the available methods, then the determination by dimensional analysis, the static experimental methods using a reference cantilever and using a nanoindenter, and the dynamic method using the cantilever's thermal vibration, with an informative annex reporting interlaboratory and intralaboratory comparisons. It took effect on 1 September 2023.

This document describes five methods for measuring the normal elastic constant of a cantilever beam with an atomic force microscopy probe: The accuracy error of the measurement is 5%~ 10%: Each method belongs to one of the three categories of dimensional method, static experimental method and dynamic experimental method: The choice of method depends on Analyze the purpose to be achieved, the convenience and the existing equipment conditions: This document is not applicable to measurement accuracy higher than 5%~10%: If you want to obtain measurement accuracy higher than 5%~10%, you need to use this document Measured by higher precision methods not mentioned in this document:

2 Normative references

The contents of the following documents constitute the essential provisions of this document through normative references in the text: Among them, dated references For documents, only the version corresponding to the date is applicable to this document; for undated reference documents, the latest version (including all amendments) is applicable to this document:

ISO 18115-2:2013 Vocabulary for surface chemical analysis Part

3 Terms and Definitions

The terms and definitions defined in ISO 18115-2 and the following apply to this document: 3:

1 Normal spring constant normalspringconstant spring constant force constant kz < AFM > The value of the normal force applied at the tip of the probe (3:2) compared to the deflection of the cantilever beam in the normal direction at the tip of the probe:

Note 1: See lateral spring constant, torsional spring constant:

Note 2: The normal spring constant is usually called the spring constant: The full name is used when distinguishing it from the lateral elastic constant:

Note 3: The force used to calculate or measure the normal elastic force constant kz of the cantilever beam is applied in the normal direction on the cantilever beam plane: In applications, the AFM cantilever may There is a theta angle inclination to the plane where the sample surface is located and the normal plane where the probe tip approaches the sample surface: This angle is very important for AFM research It is important to study the application of the normal elastic constant: 3:2 probe tip probetip needle tip probe tip probeapex The tip of the probe tip is used to sense the structure of the tip of the surface: NOTE: See top of outrigger (3:3):