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

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**Surface chemical analysis - Atomic force microscopy -
Procedure for in situ characterization of AFM probe shank
profile used for nanostructure measurement**

表面化学分析 原子力显微术 用于纳米结构测量的原子力显微镜探针柄轮廓原位
表征程序

(English Translation)

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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 13095:2014 "Surface chemical analysis - Atomic force microscopy for nanostructure measurement" in-situ characterization procedure for micromirror probe shank profile.

Introduction

The AFM imaging mechanism causes the probe to expand during imaging, which results in an expansion effect on the surface morphology of the sample.

In this case, the radius of the probe tip is in the range of 1 nm to 200 nm, which is in the same order of magnitude as many important surface topographic features.

Therefore, the shape and size of the probe used for imaging have a great influence on the obtained AFM image.

The distance between the AFM probe and the sample surface depends on the control parameters, so the control method of the distance between the AFM probe and the sample surface will also cause AFM imaging errors.

The specifications of the probe are usually expressed in terms of the probe radius and its semi-cone angle. However, the actual probe is often not so simple to describe.

This requires a quantitative description of the probe shank shape. This document describes two specific methods for determining the probe shank shape. Probe profile Projection of the probe profile (PPP) and effective probe shape characteristics (effective probe shape PPP gives the continuous contour of the probe handle, while EPSC gives several discrete feature points of the probe handle contour.

When measuring the depth of narrow grooves and other similar contour structures, EPSC can reflect the effectiveness of the probe.

The handle contour can be used to establish an accurate probe real shape structure model, and then estimate and restore the image obtained based on the probe measurement to obtain this document provides a method for quantitatively determining the shape of the AFM probe shank, thereby determining whether the probe used is it is suitable for measuring specific narrow grooves and similar contour structures, and ensures the reproducibility of AFM imaging.

Surface chemical analysis atomic force microscopy Atomic force microscopy for nanostructure measurement in-situ characterization procedure for probe shank profile

1 Scope

This document specifies two methods for characterizing the AFM probe shape, specifically the shank and subtip profiles.

By projecting the AFM probe tip profile onto a specified plane, or by projecting the features of the probe handle onto the plane under certain operating conditions Among them, the latter method can show the effectiveness of the probe when used for depth measurement of narrow grooves and similar contour structures.

The test piece is suitable for probes with a radius greater than $5u_0$, where u_0 is the uncertainty in the width of the ridge structure of the reference sample used to characterize the probe.

2 Normative references

The contents of the following documents constitute the essential clauses of this document through normative references in this document.

For referenced documents without a date, only the version corresponding to that date applies to this document; for referenced documents without a date, the latest version (including all amendments) applies to this document.

ISO 18115-2 Surface chemical analysis - Vocabulary - Part 2: Scanning probe microscopy - Terminology Note. GB/T 22461.2-2023 Surface chemical analysis vocabulary Part 2: Scanning probe microscopy terminology (ISO 18115-2:2021, MOD) ISO/T S80004-4 Nanotechnologies-Vocabulary-Part 4: Nanostructured materials Note. GB/T 30544.4-2019 Nanotechnology Terminology Part 4: Nanostructured Materials (ISO/T S80004-4:2011, IDT)

3 Terms and Definitions

For this document, the terms and definitions defined in ISO 18115-2 and ISO/T S80004-4 and the following apply.

Note: For convenience, some terms and definitions are reproduced here.

The ratio of the length of the profile at a probe location to the width of the profile at that location.

In contact mode, the scaling factor is used to convert the output of the AFM cantilever optical displacement detection system into the displacement of the probe tip.

Error signal Feedback control system signals, whose amplitude and sign are used to correct and/or calibrate the control element and the controlled element, and the position between them.

The relationship between the probe profile width and the probe profile length of a given probe reflects the influence of the actual probe shape.

where the error caused by the feedback control method and other AFM imaging methods projected onto the specified plane.