BSI Standards Publication

Surface chemical analysis — Scanning probe microscopy — Procedure for the determination of elastic moduli for compliant materials using atomic force microscope and the two-point JKR method

National foreword

This British Standard is the UK implementation of ISO 21222:2020.

The UK participation in its preparation was entrusted to Technical Committee CII/60, Surface chemical analysis.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Foreword

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This document was prepared by Technical Committee ISO/TC 201, *Surface chemical analysis*, Subcommittee SC 9, *Scanning probe microscopy*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Atomic force microscope (AFM) is a member of the scanning probe microscope (SPM) family and is used to image surfaces by mechanically scanning a probe over the surface. In AFM, a surface force is monitored as the deflection of a compliant cantilever, which has a probe tip at its free end in order to interact with surfaces. AFM can provide amongst other data: topographic, mechanical and chemical information about a surface depending on the mode of operation and the property of the probe tip. Accurate force measurements and sample deformation measurements are needed for a wide variety of applications, especially to determine the elastic moduli of compliant materials such as organics and polymers at surfaces. For quantitative force measurements, it is necessary to select an adequate contact mechanic model used to calculate the elastic modulus, and also use the appropriate calculation procedure.

This document describes a procedure for the determination of the elastic moduli for compliant materials using AFM. Force-distance curves are obtained on the surfaces of compliant materials and are used for the calculation of elastic modulus based on Johnson-Kendall-Roberts (JKR) two-point method.

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INTERNATIONAL STANDARD ISO 21222:2020

Surface chemical analysis — Scanning probe microscopy — Procedure for the determination of elastic moduli for compliant materials using atomic force microscope and the two-point JKR method

1 Scope

This document describes a procedure for the determination of elastic modulus for compliant materials using atomic force microscope (AFM). Force-distance curves on the surface of compliant materials are measured and the analysis uses a two-point method based on Johnson-Kendall-Roberts (JKR) theory. This document is applicable to compliant materials with elastic moduli ranging from 100 kPa to 1 GPa. The spatial resolution is dependent on the contact radius between the AFM probe and the surface and is typically approximately10-20 nm.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 18115-2, *Surface chemical analysis — Vocabulary — Part 2: Terms used in scanning-probe microscopy*

ISO 11775, *Surface chemical analysis — Scanning-probe microscopy — Determination of cantilever normal spring constants*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18115-2 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
force-distance curve
force-displacement curve
<AFM> pairs of force and distance values resulting from a mode of operation in which the probe is set at a fixed (x, y) position and the probe tip is moved towards or away from the surface as the force is measured

Note 1 to entry: The force is usually monitored using the cantilever deflection.

[SOURCE: ISO 18115-2:2013, 5.56]