



BSI Standards Publication

Surface chemical analysis — Scanning-probe microscopy — Measurement of drift rate

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National foreword

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

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Surface chemical analysis — Scanning-probe microscopy — Measurement of drift rate

Analyse chimique des surfaces — Microscopie par sonde à balayage — Mesurage du taux de dérive





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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 11039 was prepared by Technical Committee ISO/TC 201, *Surface chemical analysis*, Subcommittee SC 9, *Scanning probe microscopy*.

Introduction

Scanning-probe microscopy (SPM) is a well-known microscopic technique for nanoscience and nanotechnology. Working at, or close to, atomic-scale resolution, it is recognized that the time stability of such instruments is very sensitive to their design, operating environment and usage. Among the many technical specifications of SPM, the drift rate is an essential parameter. A knowledge of, and minimization of, drift in the X-, Y- and Z-directions is required for designing many experiments. It is not only important for obtaining undistorted images and series of images throughout an experiment, but is also critical when, for example, measuring physical properties, monitoring dynamic behaviour, making micro/nanoassemblies, and manipulating materials at the nanoscale. Furthermore, a knowledge of the instrumental drift rate is also important when selecting an instrument for use. It is therefore desirable that manufacturers provide suitable information about the instrumental drift characteristics in a common way. Many manufacturers provide closed-loop scanners in their instruments. Unfortunately, drift is still present, although the magnitude of the drift rate is significantly reduced. Therefore, practical methods to measure and characterize drift rates of SPM instruments in the X-, Y- and Z-directions are required and are contained in this International Standard.

Two measures, the maximum and the average drift rates, are described for both the X-Y plane and the Z-axis. The maximum drift rate is given as the maximum observed, for reasons of economy, after a small number of fairly simple measurements. The maximum drift rate allows the user to design experiments that fall within the working zone available given the duration of the intended experiments; however, the maximum observed X-Y and Z-drift rates are based on a small number of observations and are less precise than the average drift rates determined. To deduce a working zone, a rule of thumb is to assume that the maximum is twice the value of the average. Clearly, in any population, the true maximum for a very large number of measurements would be very large, but here it is expected that the user only expects some 90 % of experiments not to require repetition as a result of the drift properties of the instrument. Depending on the importance of the measurements, users may, of course, set themselves any chosen margin of safety based on the data derived using this International Standard.

Surface chemical analysis — Scanning-probe microscopy — Measurement of drift rate

1 Scope

This International Standard defines terms and specifies measurement methods for characterizing the drift rates of scanning-probe microscopy (SPM) instruments in the X- and Y-directions and, for SPM instruments measuring topography, the drift rate in the Z-direction. Though the behaviour of the long-term drift rate might be nonlinear, both that and the behaviour of the short-term drift rate after a user-defined settling time can be characterized by either typical average or typical maximum drift rates.

This International Standard is suitable for evaluating the drift rate based on SPM images. It is intended to help manufacturers quote drift figures in specifications in a meaningful and consistent manner and to aid users to characterize the drift behaviour so that effective experiments can be designed. These measurements are not designed for image correction.

2 Normative references

The following referenced documents are indispensable for the application 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*

3 Terms and definitions and abbreviated terms

3.1 Terms and definitions

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

3.1.1

drift

change in position of the probe tip, for a given positional setting by the instrument controller, relative to the test specimen

NOTE Drift occurs in all parameters (e.g. X-, Y-, Z-displacements, laser positioning on the cantilever, intensity in SNOM sources) but in this International Standard the term drift is restricted to the unintended change in position of the probe tip for given scanner X-, Y- and Z-coordinates, relative to the test specimen.

3.1.2

drift rate

quotient of the linear displacement of the probe tip, for a given positional setting, relative to the test specimen over a given time interval by that time interval

NOTE 1 The time interval is usually chosen to be the time between successive images.

NOTE 2 The drift rate may be given for each of the X-, Y- and Z-axes separately or as the magnitude of the resulting vector.