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

GB/T 22571-2017

Replacing GB/T 22571-2008

**Surface chemical analysis -- X-ray photoelectron spectrometers
-- Calibration of energy scales**

表面化学分析 X射线光电子能谱仪 能量标尺的校准

(English Translation)

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References

Foreword

This standard was drafted in accordance with the rules given in GB/T 1.1-2009.

This standard replaces GB/T 22571-2008 "surface chemical analysis X-ray photoelectron spectrometer energy scale calibration", and GB/T 22571-2008 compared to editorial changes in addition to the main technical changes are as follows.

- Modify the normative references (see Chapter 2);
- Modify some terms, added some terminology notes (see Chapter 3);
- Modify part of the instructions in Table 1 (see Chapter 5);
- Increasing the calculation of peak combined with repeatability standard deviation supplement (see Chapter 5);
- Modify the correction instrument combined with energy scale steps (see Chapter 5).

This standard uses the translation method identical with ISO 15472:2010 "surface chemical analysis of X-ray photoelectron spectrometer energy scale calibration".

This standard by the National Microbeam Analysis Standardization Technical Committee (SAC/TC38) and focal point.

This standard drafting unit. Institute of Chemistry, Chinese Academy of Sciences, Fudan University.

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This standard replaces the standards previously issued as.

--- GB/T 22571-2008.

Introduction

X-ray photoelectron spectroscopy (XPS) is widely used for surface analysis of materials. The elements of the sample (except hydrogen and helium) can be measured the photoelectron-determined core energy level binding can be identified by comparing the elements corresponding to these energies given in the table. Chemistry about these elements the state information can be derived from the chemical shifts of the characteristic peaks of photoelectrons and Auger electrons relative to the reference state. Identify the chemical state required for chemical position the measurement accuracy of the shift is 0.1 eV; therefore, measurements should be made on a one-by-one basis with a sufficiently accurate reference source. Thus requiring the XPS spectrometer of the combined energy scale calibration, the uncertainty needs to reach 0.2eV or less.

The method uses a calibrated spectrometer combined energy scale with pure copper (Cu), silver (Ag) and gold (Au) metal samples for the configuration of non-monochromated aluminum (Al) or magnesium (Mg) X-rays or monochromatic AlX rays. Its effective binding energy range of 0eV ~ 1040eV.

XPS spectrometers that may be required to provide analyzes that meet the requirements of GB/T 27025 (ISO 17025) [1] and that are calibrated for other purposes Have a statement that estimates the uncertainty of the calibration. These instruments are limited to obtaining a measure of their binding energy within a certain tolerance limit $\pm \Delta$ calibration. The value of Δ is not specified in this standard because it depends on the application and design of the XPS spectrometer. The value of Δ is based on the user of this standard Use standard experience, instrument calibration stability, the uncertainty the instrument needs to perform the binding energy measurement in the intended application, and perform calibration the amount of work required to choose. This standard provides information that can be used to select the appropriate Δ value. In general, Δ is greater than or equal to 0.1 eV and large 4 times the standard deviation of repeatability σ_R . In a well calibrated state, taking into account the instrument drift over time, the discrepancy of the reference binding energy value the 95% confidence level plus the calibration uncertainty must not exceed the selected tolerance limit. Before the spectrometer may be out of calibration, it should be recalibrated Maintain a good state. A spectrometer is recalibrated, meaning that it has been calibrated and measures taken to reduce the measurement and

reference values Difference. This difference does not have to be reduced to zero, but it is usually reduced to a fraction of the tolerance limit required for this type of analysis.

This standard does not consider all the possible defects of the instrument itself, because the required test can be very time-consuming, and need both professional knowledge and equipment. This standard is only intended to address the basic commonalities in the XPS spectrometer combined with the calibration of energy standards.

Surface Chemical Analysis X - ray Photoelectron Spectroscopy Calibration of energy ruler

1 Scope

This standard specifies a method for the general purpose of analysis X-ray photoelectron spectrometer calibration with energy scale, the spectrometer used Monochromatic Al or MgX rays or monochromatic AlX rays. It is only suitable for instruments with sputter-cleaning ion guns. This standard also Further specifies a method to establish a calibration procedure, in the middle of a certain energy value test combined with the linearity of the scale, in the high and low binding energy District to take a little to confirm the uncertainty of the calibration of the ruler, the minor drift of the ruler to be amended and the provisions of the 95% confidence level when the combined energy ruler Calibration of the extended uncertainty. This uncertainty includes the contribution from the phenomena observed in laboratory studies, but does not cover all can occur defects. This standard does not apply to the following instruments. Combined with the energy of the rod error significantly different with the energy change, the work in the solid the constant reduction ratio mode with the reduction ratio less than 10 has a resolution of less than 1.5eV or a tolerance of $\pm 0.03\text{eV}$ or less. this the standard does not provide a full scale calibration test, which verifies every point found on the energy ruler, as instructed by the instrument manufacturer Recommended procedures.

2 Normative references

The following documents for the application of this document is essential. For dated references, only the dated version applies to this article Pieces. For undated references, the latest edition (including all amendments) applies to this document.

ISO 18115-1 Glossary of surface chemical analysis - Part 1. General terms and spectroscopy terms (Surfacechemical analysis-Vocabulary-Part 1: Generaltermsandtermsusedinspectroscopy)

3 Symbols and abbreviations

The following symbols and abbreviations apply to this document.

a Measured energy ratio error b Measured zero offset error in eV Ecorr The corrected

binding energy results for a given E_{meas} in eV E_{elem} element of a frequently-measured binding energy, the value of the binding energy in the ruler has been set, after calibration can accurately read Out, the unit is eV E_{meas} measured binding energy in eV E_{meas}
 Average binding energy measured in Table 2 for the nth peak in eV E_{meas}ni Table 2, the nth peak of a group of binding energy measurement in one of the units eV E_{ref}n Reference value of the nth peak in Table 2 on the binding energy scale in eV the full width at half the maximum peak strength above the FWHM background, in eV j The number of repeated measurements of a new peak k Duplication of Au4f7/2, Cu2p3/2, and Ag3d5/2 (or CuL3VV) peaks in determining repeatability standard deviation and linearity the number of measurements m Number of repeated measurements of Au4f7/2 and Cu2p3/2 during periodic calibration n Table 2 identifies the label of the peak tx "Student" t value over x degrees of freedom distributed on both sides at 95% confidence