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Surface chemical analysis -- X-ray photoelectron spectroscopy -- Reporting of results of thin-film analysis

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Foreword

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

This standard uses the translation method equivalent to ISO 13424.2013 "Surface chemical analysis X-ray photoelectron spectroscopy film analysis results

Report".

This standard is proposed and managed by the National Microbeam Analysis Standardization Technical Committee (SAC/TC38).

This standard is mainly drafted by. Xiamen Heqing Education Consulting Co., Ltd., Department of Chemistry, Tsinghua University.

Introduction

X-ray photoelectron spectroscopy (XPS) is widely used for the characterization of material surfaces, especially for overlay films on substrates. can use

XPS measures the chemical composition of the near surface region of the film. If the film has a uniform thickness and the thickness is less than the average of the measured photoelectrons

About 3 times the depth of escape (MED), the film thickness of the film and the elements or elements in the film can be determined by variable angle XPS or peak shape analysis.

Depth analysis of the chemical state of the prime. For thicker films, depth profiling of the elements in the film can be obtained by sputtering depth profiling. If XPS

The system has sufficient lateral resolution to determine possible lateral non-uniformities in film thickness or depth profile. These XPS applications

It is especially valuable for the characterization of thin film nanostructures because MED is usually small for many material materials and conventional XPS measurement conditions.

At 5nm.

Chapters 6 and 7 of this standard are the statistical chemical composition of the cover film on the substrate for the operator of the XPS instrument and

Effective measurements made at film thickness provide guidance. Chapter 8 of this standard states that XPS data should be included in the measurement and analysis report.

Information included. Appendix A, Appendix B, Appendix C, and Appendix D provide data analysis methods for different types of XPS measurements of film samples.

Additional information.

Surface chemical analysis X-ray photoelectron spectroscopy

Report on the results of thin film analysis

1 Scope

This standard gives an explanation of the minimum amount of information required to report an analysis of a film on a substrate using XPS. These analyses involve

Measurement of chemical composition and uniform film thickness, as well as variable angle XPS, XPS sputtering depth profile, peak shape analysis and variable photon energy

The XPS approach to the measurement of the chemical composition of a non-uniform film

as a function of depth.

2 Normative references

The following documents are indispensable for the application of this document. For dated references, only dated versions apply to this article.

Pieces. For undated references, the latest edition (including all amendments) applies to this document.

ISO 18115-1.2010 Surface chemical analysis vocabulary Part 1. Generic terms and generative terms (Surfacechemicalanaly-

sis-Vocabulary-Part 1.Generaltermsandtermsusedinspectroscopy)

3 Terms and definitions

The terms and definitions defined in ISO 18115-1.2010 apply to this document.

4 Abbreviations

AES. Auger electronnspectroscopy

ARXPS. Angle-resolved X-ray photoelectron spectroscopy

IMFP. Inelastic mean free path (Inelasticmeanfreepath)

MED. Meanscapedepth (Meanescapedepth)

RSF. Relative sensitivity factor (Relativesensitivityfactor)

TRMFP. Migration mean free path (Transportmeanfreepath)

XPS. X-ray photoelectron spectroscopy

5.1 Introduction

XPS analysis of the film on the substrate provides information on the chemical composition as a function of depth and film thickness. If the total film thickness is less than

A total of three times the MED of the detected photoelectrons, a variety of XPS methods can be used. The specific photoelectron MED is IMFP and relative to the table

A function of the photoelectron emission angle of the surface normal. IMFP relies on optoelectronic energy and materials. The MED value can be found in the database [1]. in

A simple analytical formula for estimating various MED values has been published under an emission angle of <= 50° [2]. For such an emission angle, the MED is smaller than the IMFP

The product of the cosine of the emission angle, which depends on the intensity of photoelectron elastic scattering in the film [2]. Both IMFP and elastic scattering intensity

Depends on the chemical composition of the membrane. Typical MED values are less than 5 nm for many material materials and typical XPS instruments and measurement conditions. in case

The elastic scattering effect is negligible and the MED can be approximated by the product of the IMFP and the cosine of the transmitted angle. For an emission angle greater than 50°

In the case, although a better estimate can be obtained from the database [1], the latter estimate of the MED may be sufficient. If the total thickness of the film

More than 3 times the maximum value of MED. Under certain conditions, XPS with ion sputtering can be used to determine the change of chemical composition with depth.

(Appendix D provides a guide to the XPS sputtering depth profiling method and gives examples).

Table 1 summarizes the XPS methods that can be used to determine chemical composition and film thickness. Some methods can be used to characterize single or multiple layers on a substrate

Layer film, some methods can be used to determine the composition of the sample - depth profile, the composition of which is a function of the depth measured from the surface (ie there is not

Must be the interface of two or more phases). The choice of method depends primarily on the type of sample and the shape of the sample for the possible or expected sample

Understanding of the state (ie, the sample may consist of a single coating layer on a planar substrate, the multilayer film on a planar substrate, or the composition continuously changes with depth)

Sample) whether the total thickness of the film is less than or greater than the maximum MED of the photoelectron being measured, and the desired information (ie, the composition of the film or

The thickness of the film). The first three methods in Table 1 are non-destructive, while the last method is destructive (ie, the composition of the exposed surface is

It is determined by XPS that the sample is etched by ion bombardment). The following clauses give a brief description of these methods and are attached to the appendix

Additional information is provided in .

Table 1 XPS characterization method for film and composition change with depth on substrate