
**Surface chemical analysis — X-ray
photoelectron spectroscopy — Reporting
of methods used for charge control and
charge correction**

*Analyse chimique des surfaces — Spectroscopie de photoélectrons —
Indication des méthodes mises en oeuvre pour le contrôle et la
correction de la charge*



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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 19318 was prepared by Technical Committee ISO/TC 201, *Surface chemical analysis*, Subcommittee SC 5, *Auger electron spectroscopy*.

Introduction

X-ray photoelectron spectroscopy (XPS) is widely used for characterization of surfaces of materials. Elements in the test specimen (with the exception of hydrogen and helium) are identified from comparisons of the binding energies of their core levels, determined from measured photoelectron spectra, with tabulations of these binding energies for the various elements. Information on the chemical state of the detected elements can frequently be obtained from small variations (typically between 0,1 eV and 10 eV) of the core-level binding energies from the corresponding values for the pure elements. Reliable determination of chemical shifts often requires that the binding-energy scale of the XPS instrument be calibrated with an uncertainty that could be as small as 0,1 eV.

The surface potential of an insulating specimen will generally change during an XPS measurement due to surface charging, and it is then difficult to determine binding energies with the accuracy needed for elemental identification or chemical-state determination. There are two steps in dealing with this problem. First, experimental steps can be taken to minimize the amount of surface charging (charge-control methods). Second, corrections for the effects of surface charging can be made after acquisition of the XPS data (charge-correction methods). Although the buildup of surface charge can complicate analysis in some circumstances, it can be creatively used as a tool to gain information about a specimen.

The amount of induced charge near the surface, its distribution across the specimen surface, and its dependence on experimental conditions are determined by many factors including those associated with the specimen and characteristics of the spectrometer. Charge buildup is a well-studied^[1, 2] three-dimensional phenomenon that occurs along the specimen surface and into the material. Charge buildup may also occur at phase boundaries or interface regions within the depth of the specimen that is irradiated by X-rays. Some specimens undergo time-dependent changes in the level of charging because of chemical changes or volatilization induced by photoelectrons and secondary electrons, X-rays, or heating. Such specimens may never achieve steady-state potentials.

There is, at present, no universally applicable method or set of methods for charge control or for charge correction^[3, 4]. This International Standard specifies the information that shall be provided to document the method of charge control during data acquisition and/or the method of charge correction during data analysis. Information is given in Annex A on common methods for charge control and charge correction that can be useful for many applications. The particular charge-control method that may be chosen in practice depends on the type of specimen (e.g., powder, thin film or thick specimen), the nature of the instrumentation, the size of the specimen, and the extent to which the specimen surface might be modified by a particular procedure.

This International Standard is expected to have two main areas of application. First, it identifies information on methods of charge control and/or charge correction to be included in reports of XPS measurements (e.g., from an analyst to a customer or in publications) in order to evaluate, assess and reproduce data on insulating materials and to ensure that measurements on similar materials can be meaningfully compared. Second, adherence to this International Standard will enable published binding energies to be used with confidence by other analysts and will lead to the inclusion of more reliable data in XPS databases.

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Surface chemical analysis — X-ray photoelectron spectroscopy — Reporting of methods used for charge control and charge correction

1 Scope

This International Standard specifies the minimum amount of information describing the methods of charge control and charge correction in measurements of core-level binding energies for insulating specimens by X-ray photoelectron spectroscopy that shall be reported with the analytical results. Information is also provided on methods that have been found useful for charge control and for charge correction in the measurement of binding energies.

2 Normative reference

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, *Surface chemical analysis — Vocabulary*

3 Terms and definitions

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

4 Symbols and abbreviated terms

| | |
|------------------------|--|
| BE | Binding energy, in eV |
| BE _{corr} | Corrected binding energy, in eV |
| BE _{meas} | Measured binding energy, in eV |
| BE _{ref} | Reference binding energy, in eV |
| FWHM | Full width at half maximum amplitude of a peak in the photoelectron spectrum above the background, in eV |
| XPS | X-ray photoelectron spectroscopy |
| Δ_{corr} | Correction energy, to be added to measured binding energies for charge correction, in eV |