INTERNATIONAL STANDARD

ISO 18115

First edition
2001-07-15

AMENDMENT 1
2006-01-15

Surface chemical analysis — Vocabulary

AMENDMENT 1

Analyse chimique des surfaces — Vocabulaire

Amendement 1

Reference number
ISO 18115:2001/Amd.1:2006(E)

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Tel. + 41 22 749 01 11
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Published in Switzerland

Foreword

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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.

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Amendment 1 to ISO 18115:2001 was prepared by Technical Committee ISO/TC 201, *Surface chemical analysis*, Subcommittee SC 1, *Terminology*.

Introduction

In ISO 18115:2001, 350 terms for surface chemical analysis are provided. However, from time to time new terms need to be defined and these will appear in Amendments to ISO 18115. In this Amendment, five abbreviations and 71 terms are added. None of the previous terms are changed.

This Amendment has been prepared in conformance with the principles and style defined in ISO 1087-1, *Terminology work — Vocabulary — Part 1: Theory and application*, and ISO 10241, *International terminology standards — Preparation and layout*. It should be noted that, as in ISO 18115, a term printed boldface in a definition or a note is defined in another entry in the Amendment. However, the term is printed boldface only the first time it occurs in each entry. A term listed lightface is non-preferred or deprecated. The preferred term is listed boldface. Where a term designates several concepts, it is necessary to indicate the subject field to which each concept belongs. The field is shown lightface, between angle brackets, preceding the definition, on the same line.

The abbreviations given here add to those given in Clause 2 of ISO 18115. The terms given here in alphabetical order form a new Clause 6. An alphabetical index for this Amendment is given after the terms and definitions. The index for ISO 18115:2001 is given immediately after this for convenience. To assist retrieval, compound terms may be found in these indexes in both natural and reverse word order. It is recommended that users searching for a term start with these indexes.

Surface chemical analysis — Vocabulary

AMENDMENT 1

Pages 1 and 2

Add the following abbreviations:

CRM	certified reference material
dc	direct current
rf	radio-frequency
RM	reference material
RSF	relative sensitivity factor

Page 49

Add the following clause:

6 Definitions of supplementary terms for surface analysis

6.1
abundance sensitivity
⟨GDMS⟩ ratio of the maximum ion current recorded at a mass m to the ion current arising from the same species recorded at an adjacent mass ($m \pm 1$)

[IUPAC, 1997]

6.2
afterglow
⟨GDS⟩ luminescence of the decaying plasma present in a **glow discharge** device after complete cessation of the sustaining discharge power

6.3
anode
⟨GDS, dc operation⟩ more positively charged electrode in a **glow discharge** device

cf **cathode** ⟨GDS, dc operation⟩

6.4
anode
⟨GDS, rf operation⟩ electrode that is more positively charged over a large fraction of the rf cycle in a radio frequency powered **glow discharge** device

cf **cathode** ⟨GDS, rf operation⟩

NOTE 1 The rf power applied to a typical rf glow discharge device that is used for surface chemical analysis is sinusoidal and bipolar, with a time-averaged electric potential of zero relative to ground potential. The reason that the anode is not more positively charged over the entire rf cycle is that the magnitude of the **dc bias** is usually slightly less than one-half of the applied rf peak-to-peak potential.

NOTE 2 The precise fraction of the rf cycle over which the anode is more positively charged depends upon the source geometry and other factors.

6.5
anode glow

〈GDS〉 thin luminous region of a **glow discharge** immediately adjacent to the **anode**

cf. **cathode layer**, **negative glow** and **positive column**

NOTE The anode glow may not be noticeable in a glow discharge used for surface chemical analysis.

6.6
Auger vacancy satellite

Auger transition in which additional **spectator holes** are present in the **initial state** or the **final state** for the transition

6.7
background equivalent concentration

〈GDS〉 **concentration** of an element in a sample that would produce, in the absence of the background, a signal intensity equivalent to the measured background intensity

NOTE In GDS, results are often expressed in mass fractions and so the background equivalent concentration is usually expressed in these units.

6.8
background, relative standard deviation of the

quotient of the standard deviation characterizing the noise in the background signal and the background signal

6.9
cathode

〈GDS, dc operation〉 more negatively charged electrode in a glow discharge device

cf. **anode** 〈GDS, dc operation〉

6.10
cathode

〈GDS, rf operation〉 electrode that is more negatively charged over a large fraction of the rf cycle in a radio frequency powered **glow discharge** device

cf. **anode** 〈GDS, rf operation〉

NOTE 1 The rf power applied to a typical rf glow discharge device that is used for surface chemical analysis is sinusoidal and bipolar, with a time-averaged electric potential of zero relative to ground potential. The reason that the cathode is not more negatively charged over the entire rf cycle is that the magnitude of the **dc bias** is usually slightly less than one-half of the applied rf peak-to-peak potential.

NOTE 2 The precise fraction of the rf cycle over which the cathode is more negatively charged depends upon the source geometry and other factors.

6.11

cathode fall

fall potential

cathode drop

⟨GDS⟩ electric potential difference between the **cathode** surface and the **negative glow**

NOTE In direct-current **glow discharge spectrometry** typically used for surface chemical analysis, the cathode fall is usually in the range 200 V to 2 000 V, with the cathode surface being more negative. In an rf glow discharge, the cathode fall is time-varying, with a peak-to-peak value normally in the range 500 V to 2 000 V.

6.12

cathode layer

⟨GDS⟩ thin luminous region of **glow discharge** between the **Aston dark space** and the **cathode dark space**

cf. **negative glow**, **positive column** and **anode glow**

NOTE The cathode layer may not be noticeable in a glow discharge used for surface chemical analysis.

6.13

charge transfer

charge exchange

⟨GDS⟩ transfer of charge from an atom, molecule or ion to another atom, molecule or ion

6.14

charge transfer, asymmetric

charge exchange, asymmetric

⟨GDS⟩ charge transfer between an atom, molecule or ion and another atom, molecule or ion of a different chemical species

NOTE 1 For example, $Ar^+ + M \rightarrow Ar + M^{+*}$, where M is often a transition metal in GDS applications and M^{+*} is in an electronically excited, ionic state.

NOTE 2 Generally, asymmetric charge transfer is less efficient than symmetric charge transfer, arising from the effects of energy overlap and quantum mechanical considerations on reaction cross-sections.

6.15

charge transfer, symmetric

charge exchange, symmetric

⟨GDS⟩ charge transfer between an atom, molecule or ion and another atom, molecule, or ion of the same chemical species

NOTE For example, $Ar^+ + Ar \rightarrow Ar + Ar^+$. This reaction is believed to be an efficient mechanism in the **cathode dark space** of an analytical **glow discharge**, resulting in a large population of fast Ar atoms directed toward the sample surface. These fast Ar atoms may contribute significantly to sample sputtering.

6.16

chemical species

atom, molecule, ion or functional group

6.17

chemical state of an atom

⟨AES, EELS, UPS, XPS⟩ state of an atom arising from its chemical interaction with neighbouring atoms in a molecule, compound, solid, liquid or gas that leads to a characteristic energy or feature observable in electron spectroscopies

NOTE 1 Examples of features observed are satellite peaks, shifts in the peak energy positions, changes in the **lineshape** and changes in the **characteristic electron energy loss** spectra at lower **kinetic energies** than the photoelectron or **Auger electron** peaks.

NOTE 2 A full description of chemical state is denoted by the complete set of electronic states and the electron configuration in the core of the atom providing the signal, as well as the electronic and physical structure (including charge distribution, density of electronic states and electronic configuration) local to this atom.

NOTE 3 The chemical state of a selected atom is determined by its interaction (e.g. chemical bonding ionicity or covalency) with nearby atoms, most importantly its nearest neighbours. It is determined by the oxidation number of an atom in a compound, by the coordination (mostly by its stereo structure and number) and by the differences in the kinds of element in the position of the first nearest neighbour, second nearest neighbour, and so on. These all affect the effective charge and spin state of the selected atom.

NOTE 4 Different or distinguishable sets of chemical properties (different chemical states) of a chemical species may occur as a consequence of differing valence-band electronic structures, including charge distributions and electronic configurations, localized on the given chemical species. In XPS, the term “chemical state” is mostly used for characterizing measured binding energies, Auger-electron kinetic energies, and Auger parameters with different oxidation states of a given element in different chemical compounds, e.g. the Cr(III) oxidation state in Cr_2O_3 or $Cr(OH)_3$. In AES, the term “chemical state” is often used to characterize the shape of the Auger electron spectrum for the atoms of an element in different chemical environments, e.g. the shape of the carbon Auger electron spectrum for graphite and for various carbides. Differences in the chemical properties of a chemical species in various environments may result in differences in the respective peak energies, satellite structures, lineshapes or energy loss features in the corresponding Auger or photoelectron spectra.

NOTE 5 The quantum theory of atoms in molecules defines an atom in a molecule or crystal as a bounded region of real space — an open quantum system. However, there is no wave function for the atom — only for the total system. Hence, there is no state designation for the atom — only for the total system. What physics provides are expectation values of all the observables, measurable or otherwise, for the bound atom. In this sense, its state is defined within the total system by the net charge and energy of the atom and how changes of charge and energy are reflected in the observed (e.g. Auger or photoelectron) spectra.

6.18
chemical state plot
Wagner plot

〈XPS〉 plot of the measured **kinetic energy** of a sharp **Auger electron** peak versus the **binding energy** of a **photoelectron** peak for the same element

NOTE 1 Plots are usually made for a given element that can exist in different **chemical states**. Such plots are helpful in defining the state for an unknown sample where measurements of the binding energy alone are inadequate.

NOTE 2 The binding energy is usually plotted on the abscissa with values decreasing towards the right.

6.19
dark space

〈GDS〉 region of a **glow discharge** that emits little light compared to the surrounding regions, thereby appearing dark to the human eye

6.20
dark space, anode

〈GDS〉 dark space between the **positive column** and the **anode glow** in a **glow discharge**

cf. **Aston dark space**, **cathode dark space** and **Faraday dark space**

6.21
dark space, Aston

〈GDS〉 very thin dark space immediately adjacent to the cathode in a glow discharge

cf. **cathode dark space**, **Faraday dark space** and **anode dark space**

NOTE In **glow discharge spectrometry** used for surface chemical analysis, the Aston dark space is often not noticeable.

6.22
dark space, cathode

Crookes' dark space

Hittorf dark space

〈GDS〉 dark space between the **cathode layer** and the **negative glow** in a **glow discharge**

cf. **Aston dark space**, **Faraday dark space** and **anode dark space**

NOTE 1 In **glow discharge spectrometry** used for surface chemical analysis, the cathode dark space usually appears to occupy all of the space between the **cathode** surface and the negative glow.

NOTE 2 In dc glow discharge spectrometry, the cathode dark space is characterized by a large positive space charge and a strong electric field. This situation also occurs in an rf glow discharge over a large majority of the rf cycle. As a result, efficient acceleration of charged particles occurs in the cathode dark space.

6.23
dark space, Faraday

〈GDS〉 dark space between the **negative glow** and the **positive column** in a **glow discharge**

cf. **Aston dark space**, **cathode dark space** and **anode dark space**

6.24
dc bias
dc offset
self bias

〈GDS, rf operation〉 time-averaged electric potential, relative to ground, developed on the surface of the electrode to which the rf power is applied

NOTE 1 The dc bias arises as a result of the very different mobilities of the plasma electrons and the positively charged plasma ions.

NOTE 2 The dc bias effectively limits **sputtering** to the sample surface, preventing sputtering of other surfaces in contact with the plasma.

NOTE 3 For a properly designed rf **glow discharge** device used for surface chemical analysis, the magnitude of the dc bias is slightly less than one-half of the applied rf peak-to-peak potential difference.

6.25
delayed onset

X-ray energy, in an X-ray absorption spectrum, at which there is a significant increase in absorption and for which the increased absorption occurs at a higher energy than a core-level **binding energy**

NOTE For many elements, there is a significant increase in absorption when the X-ray energy is equal to the electron binding energy for a sub-shell. A delayed onset occurs for some elements and sub-shells when the corresponding increase in absorption occurs, instead, at an energy larger than the sub-shell binding energy.

6.26
energy eigenvalue

energy value of a single bound electron level in an atom, molecule, ion or solid obtained by solving the single-electron Schrödinger or Dirac equation in the Dirac-Fock representation of the electronic structure of an atom in its ground state

NOTE 1 Eigenvalues are the solutions to certain integral equations, a special case of which is the Schrödinger equation for electrons in atoms, molecules, ions or solids.

NOTE 2 In the **frozen-orbital approximation**, the **binding energy** of a hole state is given by the negative of the corresponding single-electron energy eigenvalue.

6.27
excitation, electron impact

⟨GDS⟩ electronic excitation of an atom, molecule or ion resulting from collision with an electron

NOTE 1 For example, $M + e^- \rightarrow M^* + e^-$, where M^* is a transition metal in an electronically excited state.

NOTE 2 In a **glow discharge** used for surface chemical analysis, electron-impact excitation is believed to account for most of the electronic excitations. Therefore, it is a very important physical mechanism for **glow discharge optical emission spectrometry**.

6.28
floating potential

⟨GDS⟩ electric potential that develops on an isolated substrate immersed in a plasma

NOTE An isolated substrate cannot conduct charge to other parts of the instrument. Therefore, averaged over time, the fluxes of electrons and positively charged ions to its surface must be equal. Given that electrons are much more mobile than positively charged ions, equal fluxes arise when the floating potential is typically a few volts more negative than the plasma potential.

6.29
frozen-orbital approximation

assumption that the one-electron wavefunctions of the electrons remaining in an atom or molecule are unchanged after ionization

NOTE In the frozen-orbital approximation, the **binding energy** of an electron is given by the negative of the **eigenvalue**.

6.30
glow discharge, abnormal

⟨GDS⟩ **glow discharge** operated in a current/voltage regime for which an increase in current is accompanied by an increase in voltage

cf. **glow discharge, normal** ⟨GDS⟩

NOTE Glow discharge devices used for surface chemical analysis are usually operated in the abnormal mode, rather than the normal mode. This is because abnormal operation provides sputtering of the entire exposed surface of the sample, as well as increased signal intensities.

6.31
glow discharge, boosted

⟨GDS⟩ **glow discharge** sustained by a secondary means of coupling energy into the plasma in addition to the primary means, sometimes providing enhanced analytical signals

NOTE Forms of boosting the glow discharge include the use of microwave and rf fields (not to be confused with unboosted rf glow discharge, in which rf excitation is the only power source), as well as the injection of extra plasma electrons by means of filaments or other electron sources.

6.32
glow discharge, normal

⟨GDS⟩ **glow discharge** operated in a current/voltage regime for which an increase in current is accompanied by little or no detectable change in voltage

cf. **glow discharge, abnormal** ⟨GDS⟩

NOTE Glow discharge devices used for surface chemical analysis are not usually operated in the normal mode. This is because a portion of the exposed sample surface remains unsputtered and signal intensities may be unacceptably weak. Such devices are usually operated in the abnormal mode.

6.33
glow discharge, pulsed

⟨GDS⟩ **glow discharge** in which one or more of the discharge operating parameters is intentionally varied with time in order to provide improved analytical performance

NOTE 1 The most common pulsed glow discharge involves modulation of the electrical power maintaining the plasma, according to a square wave or similar function. However, other forms of pulsed glow discharge are possible.

NOTE 2 Both pulsed direct-current and pulsed radio-frequency glow discharges have been devised.

6.34
glow discharge source, jet-assisted

glow discharge source, jet-enhanced

⟨GDS⟩ **glow discharge** device incorporating a means of directing high-velocity jets of plasma-support gas directly toward the sample surface, intended to provide enhanced analytical signals

NOTE 1 This form of glow discharge device has been used predominantly for glow discharge atomic absorption spectrophotometry. The jets enhance atomic absorption by aiding the transport of sputtered material from the sample surface into the region of the **negative glow** in which light absorption is measured.

NOTE 2 Jet-enhanced glow discharge devices find little use for **depth profiling** because the craters formed on the sample surface are not usually flat.

6.35
hole

electronic vacancy in an atom, molecule or solid

6.36
hole state

electronic configuration of an atom, molecule or solid containing a **hole**

6.37
ion beam ratio

⟨GDMS⟩ intensity of the analyte ion divided by the intensity of the matrix ion, both corrected for isotopic abundance

6.38
ionization, electron impact

⟨GDS⟩ ionization resulting from collision of an atom, molecule or ion with an electron

NOTE 1 For example, $M + e^- \rightarrow M^+ + 2e^-$, where M^+ is a transition metal ion.

NOTE 2 Electron impact ionization is possible only if the **kinetic energy** of the relative motion of the collision partners exceeds the difference between (1) the product of the magnitude of the electronic charge and the ionization potential of the particle to be ionized and (2) the potential energy of that particle prior to collision.

NOTE 3 In a glow discharge used for surface chemical analysis, electron impact ionization usually accounts for a large fraction of the total ionization occurring in the plasma. Therefore, it is a very important physical mechanism for **glow discharge mass spectrometry**.

6.39
ionization, Penning

⟨GDS⟩ ionization resulting from collision with an atom that is in an electronically excited state

NOTE 1 For example, $Ar^{ms} + M \rightarrow Ar + M^+$, where Ar^{ms} is a metastable Ar atom and M is a transition metal.

NOTE 2 Penning ionization is possible only if the sum of the excitation potential of the excited state atom and the **kinetic energy** of the relative motion of the collision partners exceeds the difference between (1) the product of the magnitude of the electronic charge and the ionization potential of the particle that is to be ionized and (2) the potential energy of that particle prior to collision.

NOTE 3 The probability of Penning ionization is directly related to the excited-state lifetime of the excited-state collision partner. For this reason, Penning ionization usually occurs through collisions with metastable species.

NOTE 4 In a glow discharge used for surface chemical analysis, Penning ionization is usually an important ionization mechanism, owing to the fact that the metastable energy levels of Ar, the discharge gas most commonly employed, lie sufficiently above the ionization potentials of most atomic analytes.

6.40
mass to charge ratio

〈GDMS, SIMS〉 mass of an ion divided by the number of electrons added or removed from it to form an ion

6.41
negative glow

glow region

〈GDS〉 region of a glow discharge from which most light is emitted and from which analytical signals for surface chemical analysis are usually derived

cf. **cathode layer**, **positive column** and **anode glow**

6.42
plasma

〈GDS〉 gas consisting of ions, electrons and neutral particles

NOTE Gases are weakly ionized in glow discharge.

6.43
plasma potential

space potential

〈GDS〉 electric potential of plasma relative to an appropriate reference such as earth potential

NOTE The plasma potential of direct-current glow discharge varies with location in the plasma. The plasma potential of an rf glow discharge varies with both location in the plasma and time, according to the phase of the rf excitation.

6.44
positive column

〈GDS〉 diffuse, luminous region of **glow discharge** between the **Faraday** and **anode dark spaces**

cf. **cathode layer**, **negative glow** and **anode glow**

NOTE The positive column is usually absent in glow discharge devices operated for surface chemical analysis, owing to the gas pressure and the small separation between the electrodes.

6.45
preburn
presputtering period

〈GDS, bulk materials〉 period during which **preburning** occurs

NOTE 1 Preburning is used for stabilizing the glow discharge. Typical preburn times for GDOES range from 30 s to 60 s, while those for GDMS may be much longer.

NOTE 2 **Glow discharge** conditions used for preburn are usually identical to those employed during signal registration. However, for some applications, they may be different.

6.46
preburning
presputtering
⟨GDS, bulk materials⟩ process of **sputtering**, prior to signal registration, employed to allow **steady-state sputtering** to be established and analytical signals to stabilize

NOTE Preburning is used for stabilizing the glow discharge.

6.47
primary electron
⟨GDS⟩ electron that enters the **negative glow** region from the **cathode dark space**, having been accelerated by the strong electric field within the cathode dark space, thereby having a **kinetic energy** that is among the highest of the kinetic energies of any electrons present within the plasma

NOTE This term is defined differently for AES, EPMA and SEM.

6.48
recombination
ion-electron recombination
⟨GDS⟩ addition of an electron to an ion with a net positive charge, resulting in a net charge that is one elementary charge unit more negative

NOTE Energy and momentum cannot be simultaneously conserved in an ion-electron recombination process that involves the collision of only an ion and an electron and that releases no additional particles. For this reason, recombination proceeds only through the involvement of a third collision partner, such as another electron or a surface, or through the release of a photon.

6.49
recombination, radiative
⟨GDS⟩ ion-electron recombination involving the release of a photon

6.50
redeposition
deposition of sputtered sample material back onto the sample surface

6.51
reference material
RM
material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials

[ISO Guide 30:1992] [8]

NOTE Some RMs involving surface properties may be in the form of wafers or foils. For these, the material is often homogeneous for the property values across the surface but not in the direction perpendicular to the surface and into the bulk. Examples are implanted silicon wafers to calibrate dopant levels or thin oxides on substrates to calibrate depth or thickness in analytical **depth profiling** instruments.

6.52
reference material, certified
CRM
reference material, accompanied by a certificate, one or more of whose property values are certified by a procedure which establishes its traceability to an accurate realization of the unit in which the property values

are expressed, and for which each certified value is accompanied by an uncertainty at a stated level of confidence

[ISO Guide 30:1992] [8]

NOTE 1 CRMs are usually prepared in batches for which the property values are determined within stated uncertainty limits by measurements on samples representative of the whole batch.

NOTE 2 All CRMs lie within the definition of “measurement standards” given in the *International vocabulary of basic and general terms in metrology (VIM)*” [10].

NOTE 3 Some RMs and CRMs have properties which, because they cannot be correlated with an established chemical structure or for other reasons, cannot be determined by exactly defined physical and chemical measurement methods. Such materials include certain biological materials such as vaccines to which an international unit has been assigned by the World Health Organization.

6.53
reference method

thoroughly investigated method, clearly and exactly describing the necessary conditions and procedures, for the measurement of one or more property values that has been shown to have accuracy and precision commensurate with its intended use and that can therefore be used to assess the accuracy of other methods for the same measurement, particularly in permitting the characterization of a **reference material**

[ISO Guide 30:1992] [8]

6.54
relative sputtering rate

quotient of the **sputtering rate** of a sample and the sputtering rate of a reference sample sputtered under the same conditions

6.55
relaxation

process by which an atom, molecule or ion is transformed from a higher potential-energy state to a lower potential-energy state

cf. **relaxation, electronic**

6.56
relaxation, electronic

relaxation resulting from the transition of an electron between energy levels, resulting in the release of energy

NOTE The energy release may result in the ejection of a photon or other particle.

6.57
sample area viewed by the analyser

two-dimensional region of a sample surface, measured in the plane of that surface, from which the analyser can collect an analytical signal from the sample or a specified percentage of that signal

6.58
secondary cathode

⟨GDS⟩ electrically conductive mask, containing an aperture, used to enable **sputtering** of an electrically nonconductive sample surface in a direct-current **glow discharge** device

NOTE 1 The secondary cathode is placed in direct contact with the insulating sample surface, and both the secondary cathode and the surface of the sample within the aperture are exposed to the glow discharge. The secondary cathode is held at **cathode** potential, resulting in sputtering of its surface. Some of the material sputtered from the secondary cathode is deposited onto the insulating-sample surface within the aperture, causing that surface to become electrically conductive. This results in sputtering of the insulating sample.

NOTE 2 When electrically nonconductive samples must be analysed, the secondary cathode technique provides a useful alternative to an rf glow discharge.

6.59
secondary electron

〈GDS〉 electron in the plasma with **kinetic energy** intermediate between the kinetic energies of **primary electrons** and **thermalized electrons**

NOTE This term is defined differently for general use at 5.265 in ISO 18115. Both definitions are used in GDS, depending on the context.

6.60
self-absorption

〈GDOES〉 absorption of emitted light by species identical to the emitting species positioned between the emitting species and the optical detector

NOTE Self-absorption results in non-linear calibration curves. Further, it produces broadened spectral peaks, because the probability of photon absorption is at a maximum near the peak maximum.

6.61
self-reversal

〈GDOES〉 severe **self-absorption** that produces a local minimum of intensity near the centre of a spectral peak

6.62
sensitivity factor, average matrix relative
AMRSF

〈AES, XPS〉 coefficient proportional to the intensity calculated for an element in an average matrix with which the measured intensity for that element is divided in calculations to yield the atomic concentration or atomic fraction of the element present in the sample

cf. **relative elemental sensitivity factor**, **pure element relative sensitivity factor**

NOTE 1 The choice of use of atomic concentration or atomic fraction should be made clear.

NOTE 2 The type of sensitivity factor used should be appropriate for the equations used in the quantification process and for the type of sample analysed, for example a homogeneous sample or one with segregated layers.

NOTE 3 The source of the sensitivity factors should be given. **Matrix factors** are taken to be unity for average matrix relative sensitivity factors.

NOTE 4 Sensitivity factors depend on parameters of the excitation source, the spectrometer and the orientation of the sample to these parts of the instrument. The numerical values of the sensitivity factors may also depend on the method used to measure the peak intensities.

6.63
sensitivity factor, pure element relative
PERSF

〈AES, XPS〉 coefficient proportional to the intensity measured for a pure sample of an element with which the measured intensity for that element is divided in calculations to yield the atomic concentration or atomic fraction of the element present in the sample

cf. **relative elemental sensitivity factor**, **average matrix relative sensitivity factor**

NOTE 1 The choice of use of atomic concentration or atomic fraction should be made clear.

NOTE 2 The type of sensitivity factor used should be appropriate for the equations used in the quantification process and for the type of sample analysed, for example a homogeneous sample or one with segregated layers.

NOTE 3 The source of the sensitivity factors should be given in order to be permit a check that the correct matrix factors or other parameters have been used. **Matrix factors** are significant and should be used with pure element relative sensitivity factors.

NOTE 4 Sensitivity factors depend on parameters of the excitation source, the spectrometer and the orientation of the sample to these parts of the instrument. The numerical values of the sensitivity factors may also depend on the method used to measure the peak intensities.

6.64
sensitivity factor, relative
RSF

⟨GDMS⟩ coefficient for an element with which the measured intensity of a mass peak for that element, divided by the measured intensity of a mass peak of a matrix element, is multiplied to yield the mass fraction of that element in the sample divided by the mass fraction of the matrix element

NOTE For a given GDMS instrument, the relative sensitivity factors for all elements in the periodic table usually fall within approximately one order of magnitude, making semiquantitative GDMS analysis possible without the use of reference materials for calibration. However, quantitative GDMS analysis requires the use of **reference materials** with a matrix similar to that of the sample in order to measure the relative sensitivity factors for the elements of interest in that matrix using that particular GDMS instrument.

6.65
sheath
electrode sheath

⟨GDS⟩ region of plasma adjacent to an electrode surface, characterized by a **plasma potential** that changes with distance from the electrode, being equivalent to the electrode potential at the electrode surface and approaching the plasma potential of the surrounding plasma at sufficiently large distances

NOTE These terms are usually applied to an rf **glow discharge**, though they may also be applied to a dc glow discharge.

6.66
sheath potential

⟨GDS⟩ electric potential drop across a **sheath**

NOTE In surface chemical analysis, this term is usually applied to an rf glow discharge, rather than to a dc glow discharge, where such terms as **cathode fall** are much more commonly employed. However, sheath potential may also be applied to a dc glow discharge.

6.67
spectator hole
hole state in the electronic structure of an atom that may be present during processes such as Auger electron and X-ray photoelectron emission but is not created or destroyed in the process

6.68
steady-state sputtering

⟨AES, GDS, SIMS⟩ state of the **sputtering** process in which important operational and analytical parameters are unchanging over a meaningful timescale

cf. **stoichiometric sputtering**

NOTE Generally, steady-state and stoichiometric sputtering are equivalent but, in profiling dilute **delta layers** in semiconductors, for example, the sputtering may be steady-state whilst the constituents being studied are not being sputtered in their stoichiometric ratio.

6.69
stoichiometric sputtering

⟨AES, GDS, SIMS⟩ state of the **sputtering** process in which the relative amounts of the elemental components sputtered from a sample are equal to their stoichiometry within the sample

cf. **steady-state sputtering**

NOTE For most homogeneous materials, stoichiometric sputtering is attained after the sputter removal of a few nanometres from the surface.

6.70
sum rule

⟨dielectric function⟩ equation that gives the value of an integral of a specified dielectric function

NOTE 1 Equations have been derived that give expected values of integrals of the imaginary part of the complex dielectric constant and of the imaginary part of the reciprocal of the complex dielectric constant for any material. The integrals involve the product of the specified dielectric function and either frequency or inverse frequency from zero frequency to infinite frequency. The values of each integral can be used to assess the internal consistency of a set of dielectric data for a material by comparing values of the specified integrals to expected values. In practice, the integrations are made from low frequencies (corresponding to infrared or visible photon energies) to frequencies much higher than those corresponding to the largest K-shell binding energy of atoms in the material.

NOTE 2 The integral of the product of the specified dielectric function and frequency is proportional to the total number of electrons per atom or molecule in the material. This sum rule is often referred to as the f-sum rule, the oscillator-strength sum rule or the Thomas-Reiche-Kuhn sum rule.

6.71
thermalized electrons

ultimate electrons

⟨GDS⟩ electrons, following collisions in the plasma, with an equilibrium energy distribution corresponding to the plasma temperature

Page 52

Add the following references to the bibliography:

[7] IUPAC, *Compendium of Chemical Terminology*, 2nd Edition, eds A.D. McNaught and A. Wilkinson, Blackwell, London, 1997

[8] ISO Guide 30:1992, *Terms and definitions used in connection with reference materials*

[9] ISO Guide 32, *Calibration in analytical chemistry and use of certified reference materials*

[10] *International vocabulary of basic and general terms in metrology*, published jointly by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML, 1993

Page 53

Add the following alphabetical index of the terms included in this Amendment. The alphabetical index of terms in ISO 18115:2001 is also included for information.

Alphabetical index of supplementary terms in this Amendment

Alphabetical index of terms in ISO 18115:2001