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NOMENCLATURE FOR RADIOANALYTICAL CHEMISTRY

(IUPAC Recommendations 1994)

Prepared for publication by

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Nomenclature for radioanalytical chemistry (IUPAC Recommendations 1994)

Synopsis

Nearly 200 terms commonly used in radioanalytical chemistry are unambiguously defined. The list is partially based on an earlier IUPAC-glossary (Pure Appl. Chem. 54 (1982) 1533-1554), but some modifications have been made, terms related to nuclear physics and technology have not been reconsidered and numerous new entries from the realm of radiometric analysis, radioimmunoassay and related techniques have been included.

INTRODUCTION

In 1982, IUPAC issued a Glossary of Terms used in Nuclear Analytical Chemistry [1], listing nearly 400 terms which are of interest in nuclear analysis. In the present compilation, a number of definitions from this 1982 glossary have been repeated. However, less emphasis has been placed on terms from the realm of nuclear technology, nuclear physics and radioactivity measurements. For such terms, the earlier glossary should be consulted.

In the present work, many new terms have been included, which are relevant in radiometric analysis, in radioimmunoassay and related techniques. The choice of the terms has mostly been based on practical experience. The compilers selected those terms that were either ambiguous or confusing, or which are not obvious or clear to novices in radioanalytical chemistry.

The present glossary is directed to chemists who exploit radioactivity, in any way, for quantitative analysis, and to those working in clinical chemistry, biochemistry, nuclear medicine and related disciplines.

DIRECTIONS FOR USE

The terms are listed in alphabetical order.

A term may consist of more than one word. If the term consists of an adjective and a noun, it will be listed alphabetically according to the noun followed by a comma and the adjective (e.g. counting, absolute). It will also be listed as the adjective followed by the noun with reference to the place of definition (e.g. absolute counting : see counting, absolute). When, however, the adjective is an essential attribute to the noun, the term is listed alphabetically according to the adjective. In case a term consists of two nouns, it will be listed alphabetically.

When a term consisting of two parts is given with the second part preceded by a comma and placed between parentheses, this indicates that the term basically consists of the first part, which may be preceded by the part given between parentheses.

NOMENCLATURE

ABSOLUTE ACTIVATION ANALYSIS : See : *activation analysis, absolute*

ABSOLUTE COUNTING : See : *counting, absolute*

ACTIVATION. The process of inducing *radioactivity* by *irradiation*. In general, a specification is added of the type of incident *radiation* (e.g. nuclear, neutron, photon) or its *energy* (e.g. thermal, fast) [1].

ACTIVATION ANALYSIS (NUCLEAR). A kind of elemental or isotopic analysis based on the measurement of characteristic radiation from *nuclides* formed directly or indirectly by *activation* of the test portion. In general, a specification is added of the type of the incident radiation (e.g. neutron, photon) and its *energy* (e.g. thermal, fast) (adapted from ref. [1]).

ACTIVATION ANALYSIS, ABSOLUTE. A kind of activation analysis in which the elemental concentrations in the material are calculated from known nuclear constants, irradiation and measurement parameters, rather than by comparing with known standards.

ACTIVATION ANALYSIS, INSTRUMENTAL. A kind of *activation analysis* in which element specificity is obtained by using appropriate *irradiation* conditions, *radiation* measurement techniques and mathematical techniques for the interpretation of the measurement results [1].

ACTIVATION ANALYSIS, RADIOCHEMICAL. A kind of *activation analysis* in which, after the *irradiation*, chemical or physical separation is applied.

ACTIVITY (OF A RADIOACTIVE MATERIAL). The number of *nuclear decays* occurring in a given quantity of material in a small time interval, divided by that time interval. Often, this term is referred to as absolute activity. Synonymous with: *disintegration rate* [1] or *decay rate*. Symbol: $\underline{A} = -d\underline{N}/d\underline{t}$.

ACTIVITY, MOLAR. For a specified *isotope*, the *activity* of the compound divided by the amount of the material in moles. Symbol: $\underline{A}_m = \underline{A}/\underline{n}$.

ACTIVITY, SPECIFIC. For a specified *isotope*, or mixture of *isotopes*, the *activity* of a material divided by the mass of the material (adapted from ref. [1]). Symbol: $\underline{a} = \underline{A}/\underline{m}$.

ASSAY. A set of operations having the object of determining a value of a quantity. In analytical chemistry, this term is synonimous of measurement.

ASSAY KIT. A set of components (reagents and other necessary materials) and procedural instructions packaged together and designed for the estimation in vitro of a value of a specified quantity, when used according to the instructions.

AUTORADIOGRAPH. A *radiograph* of an object containing *radioactive* substance, produced by placing the object adjacent to a photographic plate or film [1] or a fluorescent screen.

AUTORADIOLYSIS. *Radiolysis* of a *radioactive* material resulting directly or indirectly from its *radioactive decay*.

BACKGROUND RADIATION. *Radiation* from any *source* other than the one it is desired to detect or measure [1].

BARN. A former unit of area used in expressing nuclear *cross-sections*. (1 barn = 1b = $10^{-28}m^2$).

BECQUEREL. SI unit of *activity* equal to one *nuclear decay* per second (symbol : Bq) [1].

CAPTURE. A process in which an atomic or nuclear system acquires an additional particle. In general a specification is added of the type of the captured particle or its *energy* [1].

CAPTURE CROSS-SECTION. The cross-section for *capture* [1].

CAPTURE GAMMA RADIATION. The gamma *radiation* emitted in radiative capture [1].

CARRIER. A substance in appreciable amount which, when associated with a *tracer* of a specified substance, will carry the *tracer* with it through a chemical or physical process, or prevent the *tracer* from undergoing nonspecific processes due to its low concentration.

CARRIER-FREE. See: *no carrier added*, which term should be preferred.

CARRIER, HOLD-BACK. A *carrier* used to prevent a particular species from following other species in a chemical or physical operation (adapted from ref. [1]).

CARRIER, ISOTOPIC. A *carrier* which differs only in isotopic composition from the trace it has to carry [1].

CHEMISTRY, NUCLEAR. The part of chemistry which deals with the study of nuclei and nuclear reactions using chemical methods [1].

COMPARATOR. A known amount of an element that is simultaneously irradiated with the test portion in the context of activation *analysis*. If one comparator is used (single comparator method), it is essentially identical to a *flux monitor* (except that this term is not necessarily linked to *activation analysis*).

COMPETITIVE BINDING ASSAY. An *assay* based on the competition between a labelled and an unlabelled ligand in the reaction with a receptor binding agent (e.g. antibody, receptor, transport protein).

COUNT.
1. Information corresponding to a pulse processed for counting
2. Number of pulses recorded during a measurement [1].

COUNTER, RADIATION. *Radiation* measuring assembly comprizing a *radiation detector* in which individual ionizing events cause electrical pulses and the associated equipment for

processing and counting the pulses. Often an expression is added indicating the type of radiation detector (e.g. *scintillation*, *semiconductor*) [1].

COUNTING, ABSOLUTE. A measurement under such well-defined conditions that the *activity* of a sample can be derived directly from the observed *counting rate* [1].

COUNTING EFFICIENCY. The ratio between the number of particles or photons counted with a *radiation counter* and the number of particles or photons of the same type and *energy* emitted by the radiation *source*.

COUNTING LOSS. A reduction of the counting rate resulting from phenomena such as the resolving time or the *dead time* [1].

COUNTING RATE. The number of *counts* occurring in unit time [1].

CROSS REACTION. Ability of substances other than the analyte to bind to the binding reagent and ability of substances other than the binding reagent to bind the analyte in *competitive binding assays*.

CROSS-SECTION (,MICROSCOPIC). A measure of the probability of a specified interaction or reaction between an incident radiation and a target particle or system of particles. It is the reaction rate per target particle for a specified process divided by the flux density of the incident radiation. In general, a specification is added of the type of radiation (e.g. neutron, photon), the *energy* of the incident radiation (e.g. thermal, epithermal, fast) and the type of interaction of reaction (e.g. *activation*, *fission*, scattering) [1]. Symbol: σ.

CROSS-SECTION, ACTIVATION. The *cross-section* for the formation of a *radionuclide* by a specified reaction [1].

CROSS-SECTION, CAPTURE. The *cross-section* for *capture* [1].

CROSS-SECTION, EFFECTIVE THERMAL. A fictitious *cross-section* for a specified reaction, which, when multiplied by the 2200-metre-per-second *flux density*, gives the correct reaction rate for thermal neutrons [1].

CROSS-SECTION, MACROSCOPIC. The *cross-section* per unit volume of a given material for a specified process. For a pure *nuclide*, it is the product of the *microscopic cross-section* and the number of target nuclei per unit volume; for a mixture of *nuclides*, it is the sum of such products [1].

CROSS-SECTION, WESTCOTT. See : *cross-section, effective thermal.*

CURIE. A former unit of *activity* equal to exactly 37×10^9 *nuclear decays* per second or 37×10^9 *Becquerel* (37 GBq).

DAUGHTER PRODUCT. Any *nuclide* which follows a specified *radionuclide* in a *decay chain* [1].

DEAD TIME. Of a *radiation counter*, the constant and known value imposed on the resolving time, usually in order to make the correction for resolving time losses more accurate.

DEAD TIME CORRECTION. Correction to be applied to the observed number of pulses in order to take into account the number of pulses lost during the resolving or dead time [1].

DECAY CHAIN. A series of *nuclides* in which each member transforms into the next through *nuclear decay* until a stable *nuclide* has been formed.
Synonymous with : radioactive chain and radioactive series [1].

DECAY CONSTANT. For a *radionuclide* : the probability for the nuclear *decay* of one of its nuclei in unit time. It is given by

$$\lambda = - (dN_i/dt)/N_i$$

in which N_i is the number of nuclei of concern existing at time t [1].
Synonymous with : disintegration constant.

DECAY CURVE. A graph showing the relative amount of *radioactive* substance remaining after any time interval [1].

DECAY, RADIOACTIVE. *Nuclear decay* in which particles or electromagnetic *radiation* are emitted or the nucleus undergoes spontaneous fission or electron capture.

DECAY RATE. See: *activity*

DECAY, NUCLEAR. A spontaneous nuclear transformation [1].

DETECTOR EFFICIENCY (,INTRINSIC). The ratio of the number of particles or photons detected to the number of similar particles or photons which have struck the envelope limiting the sensitive volume of a *radiation detector* [1].

DETECTOR, RADIATION. An apparatus or substance for the conversion of *radiation energy* to a kind of energy which is suitable for indication and/or measurement [1].

DETECTOR, SCINTILLATION. See : scintillation detector.

DETECTOR, SEMICONDUCTOR. See : *semiconductor detector.*

DISINTEGRATION RATE. See : *activity.*

EFFECTIVE CADMIUM CUT-OFF ENERGY. In a given experimental configuration, the *energy* value determined by the condition that the *detector* response would be unchanged if the cadmium cover surrounding the detector was replaced by a fictitious cover opaque to neutrons with *energy* below this value and transparent to neutrons with *energy* above this value [1].

EFFICIENCY (OF A COUNTER). See : *counting efficiency.*

EFFICIENCY, INTRINSIC. See : *detector efficiency.*

ENERGY (OF A RADIATION). *Energy* of the individual particles or photons of which a *radiation* consists [1].

ENERGY RESOLUTION. A measure, at given *energy*, of the smallest difference between the energies of two particles or photons capable of being distinguished by a radiation spectrometer [1].

ENERGY THRESHOLD. The limiting kinetic *energy* of an incident particle or *energy* of an incident photon below which a specified process cannot take place (adapted from ref. [1].).

EQUILIBRIUM, RADIOACTIVE. Among the members of a *decay chain*, the state which prevails when the ratios between the *activities* of successive members remain constant. (This is not an equilibrium in the strict sense since *radioactive decay* is an irreversible process) (adapted from ref. [1].

FILTER (OF A RADIATION). Material interposed in the path of *radiation* to modify the spectral distribution of the *radiation* [1].

FISSION, NUCLEAR. The division of a nucleus into two or more parts with masses of equal order of magnitude, usually accompanied by the emission of neutrons, gamma radiation and, rarely, small charged nuclear fragments [1].

FLUORESCENCE. *Luminescence* which occurs essentially only during the *irradiation* of a substance by electromagnetic *radiation.*

FLUORESCENCE YIELD. See: *yield, fluorescence.*

FLUX DENSITY, ENERGY. For mono-directional *radiation*, the energy traversing in a time interval a small area perpendicular to the direction of the energy flow, divided by that time interval and by that area [1].

FLUX DENSITY, PARTICLE (or, PHOTON). At a given point in space, the number of particles (or photons) incident in a time interval on a suitably small sphere centered at that point, divided by the cross-sectional area of that sphere and by that time interval. The particle flux density is identical with the product of the particle density and the average speed of the particles [1].

FLUX DEPRESSION. The lowering of the particle (or photon) *flux density* in the neighbourhood of an object due to absorption of particles (or photons) in the object (adapted from ref. [1]).

FLUX MONITOR.
1. A substance or device to measure a *flux density*
2. A known amount of material irradiated together with a test portion; the induced *radioactivity* is used as a measure for a particular *flux density* during the *irradiation.*

FLUX PERTURBATION. The change of the *flux density* or *energy* distribution of particles or photons in an object as a result of effects such as *flux depression* and *self-shielding.*

FRACTION, BOUND. The fraction of the incubation mixture which, after separation, contains the analyte bound to the binding reagent.

FRACTION, FREE. The fraction of the incubation mixture which does not contain the bound analyte.

GEOMETRY (COUNTING). A term used colloquially to signify the arrangement in space of the various components in an experiment, particularly the *source* and the *detector* in *radiation* measurements [1].

GEOMETRY FACTOR. The average solid angle in sterradians at a *source* subtended by the aperture or sensitive volume of the detector, divided by 4π [1].

GROWTH CURVE (OF ACTIVITY). Curve giving the *activity* of a *radioactive nuclide* as a function of time and showing the increase of the *activity* through the *decay* of the *precursor* or as a result of *activation* (adapted from ref. [1].

HALF LIFE, BIOLOGICAL. For a substance the time required for the amount of that substance in a biological system to be reduced to one half of its value by biological processes, when the rate of removal is approximately exponential.

HALF LIFE, EFFECTIVE. For a *radioactive* substance, the time required for the amount of that substance in a biological system to be reduced to one half of its value by both *radioactive decay* and biological processes, when the rate of removal is approximately exponential [1].

HALF LIFE (OF RADIONUCLIDE). For a single *radioactive decay* process, the time required for the *activity* to decrease to half its value by that process [1].

HALF THICKNESS. The thickness of a specified substance which, when introduced into the path of a given beam of *radiation*, reduces the value of a specified *radiation* quantity by one half [1].

HOLD-BACK CARRIER. See : *carrier, hold back.*

HOT ATOM. An atom in an excited energy state or having kinetic energy above the ambient thermal level, usually as a result of nuclear processes [1].

HOT CELL. A heavily shielded enclosure for highly *radioactive* materials. It may be used for their handling or processing by remote means or for their storage [1].

IMMUNOASSAY. *Assay* based on the immunological binding of a specific antigen or antibody with the component under study.

IMMUNORADIOMETRIC ASSAY. *Assay* based on the reversible and non-covalent binding of an antigen by a specific antibody labelled with a *radioactive nuclide* as a *tracer.*

IMMUNORADIOMETRIC ASSAY, TWO-SITE. *Immunoradiometric assay* involving two sets of antibodies, one of which is labelled, that combine with different immunoreactive sites of an antigen molecule.

IONIZING RADIATION. Any *radiation* consisting of directly or indirectly ionizing particles or a mixture of both, or photons with *energy* higher than the *energy* of photons of ultraviolet light or a mixture of both such particles and photons [1].

IRRADIATION. Exposure to *ionizing radiation* [1].

ISOTOPES. *Nuclides* having the same atomic number but different mass numbers [1].

ISOTOPE DILUTION. Mixing of a given *nuclide* with one or more of its *isotopes* [1].

ISOTOPE DILUTION ANALYSIS. A kind of quantitative analysis based on the measurement of the isotopic abundance of a *nuclide* after *isotope dilution* with the test portion (adapted from ref. [1]).

ISOTOPE DILUTION ANALYSIS, DIRECT (RADIOCHEMICAL). *Isotope dilution analysis* used for the determination of a non-radioactive element with the aid of one of its *radionuclides*.

ISOTOPE DILUTION ANALYSIS, REVERSED (RADIOCHEMICAL). *Isotope dilution analysis* used for the determination of the isotopic carrier in a solution of a *radionuclide* with the aid of one of its stable isotopes.

ISOTOPE DILUTION ANALYSIS, SUBSTOICHIOMETRIC. A kind of *isotope dilution analysis* in which the final isotopic abundance is estimated from the amount of the *nuclide* present in a known quantity of the relevant element separated from the test portion, where this quantity is smaller than the total amount of that element present in the test portion [1].

ISOTOPE EFFECT. The difference in behaviour between two substances of which only the mass numbers of one or more constituting atoms are different.

ISOTOPE EXCHANGE. The exchange of places between *isotopes* of atoms in different chemical or physical states or positions.

ISOTOPE EXCHANGE ANALYSIS. A kind of quantitative analysis based on the *isotope exchange* between *isotopes* of the element to be determined and other *isotopes* of this element in different valency states or in different molecules.

ISOTOPIC CARRIER. See: *carrier, isotopic.*

ISOTOPIC TRACER. See: *tracer, isotopic.*

LABEL. A marker, tag or indicator distinguishable by the observer but not by the system and used to identify a *tracer* [1].

LABELLING. Providing a substance with a *label.*

LABELLING, CONJUGATION. *Labelling* of a substance by conjugation with a labelled molecule.

LABELLING, EXCHANGE. *Labelling* of a substance by *isotope exchange.*

LABELLING, ISOTOPIC. *Labelling* in which the resulting product is only different from the initial one by its isotopic composition.

LABELLING, NON-ISOTOPIC. *Labelling* in which the resulting product has a different chemical composition from the initial one.

LABELLING, RECOIL. *Labelling* by a chemical reaction initiated by *recoil.*

LABELLING, WILZBACH. *Labelling* of a substance by exposing it to tritium gas.

LIQUID SCINTILLATION DETECTOR. A *scintillation detector* in which the test portion is mixed with a liquid *scintillator.*

LIVE TIME. For a measurement, the time during which a *radiation* measuring assembly is capable of processing events occurring in the radiation detector. It equals the clock time minus the integrated resolving or *dead time* [1] (to be distinguished from "life time").

LOGIT. *In competitive binding assays*, the logit-log dose relationship, in which the response is defined by : $\underline{R} = \text{logit}(\underline{y}) = \log [\underline{y}/(1-\underline{y})]$ where $\underline{y} = \underline{b}/\underline{b}_o$ with $\underline{b}$ = fraction of *tracer* bound and $\underline{b}_o$ = value of $\underline{b}$ with no unlabelled *ligand* in the system. Logit transformed assay data frequently yield straight-line dose-response curves, amenable to statistical analysis.

LUMINESCENCE. A phenomenon in which the absorption of *energy* by a substance gives rise to the emission of electromagnetic *radiation* characteristic for the substance [1].

MODERATOR. A material used to reduce the neutron *energy* by scattering without appreciable *capture* [1].

NEUTRON DENSITY. The number of free neutrons divided by the containing volume. Partial densities may be defined for neutrons characterized by such parameters as *energy* and directions [1].

NEUTRONS, EPICADMIUM. Neutrons of kinetic *energy* greater than the *effective cadmium cut-off energy* [1].

NEUTRONS, EPITHERMAL. Neutrons of kinetic *energy* greater than that of thermal agitation. The term is often restricted to energies just above thermal [1].

NEUTRONS, FAST. Neutrons of kinetic *energy* greater than some specified value. This value may vary over a wide range and will be dependent upon the application (adapted from ref. [1]).

NEUTRONS, RESONANCE. Neutrons whose *energy* corresponds to the resonance *energy* of a specified *nuclide* or element. If the *nuclide* is not specified, the term refers to resonance neutrons of ^{238}U [1].

NEUTRONS, THERMAL. Neutrons in thermal equilibrium with the medium in which they exist [1], in general at room temperature.

NO CARRIER ADDED. A preparation of a *radioactive isotope* which is essentially free from stable *isotopes* of the element in question.

NUCLEAR CHEMISTRY. See: *chemistry, nuclear.*

NUCLEAR DECAY. See: *decay, nuclear.*

NUCLIDE. A species of atom, characterized by its mass number, atomic number and nuclear energy state, provided that the mean life in that state is long enough to be observable [1].

PEAK ANALYSIS. The extraction of relevant peak parameters (i.e. position, area) from a measured spectrum [1].

PEAK AREA METHOD. A kind of *peak analysis* in which a peak area is calculated by subtracting an estimate of the underlying continuum in a relevant part of a measured spectrum [1].

PEAK FITTING. A kind of *peak analysis* in which a relevant part of a spectrum is fitted with a theoretical response function [1].

PILE-UP. The processing by a *radiation* spectrometer of pulses resulting from the simultaneous absorption of independent particles or photons in a *radiation detector*. As a result they are counted as one single particle or photon with *energy* between the individual energies and the sum of these energies [1].

PRECURSOR. Of a *nuclide*, any *radioactive nuclide* which preceeds that *nuclide* in a *decay chain* [1].

PURITY, RADIOCHEMICAL. For a material, the fraction of the stated *isotope* present in the stated chemical form [1].

PURITY, RADIONUCLIDIC. For a material, that fraction of the total *activity* which is present in the form of the stated *radionuclide*, including *daughter* products [1].

QUENCHING.
1. The process of inhibiting continuous or multiple discharges following a single ionizing event in certain types of *radiation detectors*, particularly in Geiger-Müller counter tubes [1].
2. The deactivation of an electronically excited state by interaction with the external environment through a non-radiative process. This may lead to spectral shift or counting losses.

QUENCHING CORRECTION. Correction for errors due to different *quenching* for standards and test portions. When using *liquid scintillation detectors*, these corrections can be based e.g. on the standard addition or sample channels ratio method or the use of automated external standardization.

RADIATION. A term embracing electromagnetic waves as well as fast moving particles [1]. In *radioanalytical chemistry*, the term usually refers to radiation emitted during nuclear process (*radioactive decay*, nuclear reactions, *nuclear fission*, accelerators).

RADIATION CHEMISTRY. The part of chemistry which deals with the chemical effects of *ionizing radiation*, as distinguished from photochemistry associated with visible and ultraviolet electro-magnetic *radiation* [1].

RADIATION DETECTOR. See: *detector, radiation.*

RADIOACTIVE. The property of a *nuclide* of undergoing spontaneous nuclear transformations with the emission of *radiation.*

RADIOACTIVE DECAY. See: *decay, radioactive.*

RADIOACTIVE SOURCE. See: *source, radioactive.*

RADIOACTIVITY. The property of certain *nuclides* of showing *radioactive decay* [1].

RADIOANALYTICAL CHEMISTRY. The part of analytical chemistry in which the application of *radioactivity* is an essential step in the analytical procedures.

RADIOCHEMICAL PURITY. See: *purity, radiochemical.*

RADIOCHEMICAL SEPARATION. See: *separation, radiochemical.*

RADIOCHEMICAL YIELD. See: *yield, radiochemical.*

RADIOCHEMISTRY. That part of chemistry which deals with *radioactive* materials. It includes the production of *radionuclides* and their compounds by processing irradiated materials or naturally occurring *radioactive* materials, the application of chemical techniques to nuclear studies, and the application of *radioactivity* to the investigation of chemical, biochemical or biomedical problems (adapted from [1]).

RADIOENZYMATIC ASSAY. *Assay* of the catalytic activity of an enzyme based on the use of a *radioactive* substrate.

RADIOGRAPH. A visual representation of an object produced by placing the object between a source of *ionizing radiation* and a photographic plate or film.

RADIOGRAVIMETRIC ANALYSIS. A kind of quantitative analysis in which the *activity* of a precipitate is used as a measure of its mass.

RADIOIMMUNOASSAY. An *assay* based on the reversible and non-covalent binding of an antigen (hapten) by a specific anitibody employing radioactively labelled antigen (hapten) to measure the fraction of the antigen (hapten) bound to a substoichiometric amount of antibody.

RADIOIMMUNOASSAY, SOLID PHASE ANTIBODY. A kind of *radioimmunoassay* employing an antibody bound to a solid phase.

RADIOIODINATION. The process of incorporating the *radionuclides* of iodine (usually ^{125}I, ^{131}I or ^{123}I) into, or of covalently linking a radioiodinated substance to a substance.

RADIOISOTOPE. A *radioactive isotope* of a specified element.

RADIOISOTOPE DILUTION ANALYSIS. A kind of *isotope dilution analysis* making use of a *radionuclide*.

RADIOLYSIS. The chemical decomposition of materials by *ionizing radiation* [1].

RADIOMETRIC ANALYSIS. A kind of quantitative analysis in which measurement of the *activity* is an essential step.

RADIOMETRIC TITRATION. A titration in which a *radioactive* indicator is used to monitor the end-point of the titration.

RADIONUCLIDE. A *nuclide* that is *radioactive.*

RADIORECEPTOR ASSAY. *Assay* employing a radioactively *labelled* receptor protein as a *tracer.*

RADIORELEASE ANALYSIS. A kind of quantitative analysis based on the release of *radioactivity* from the reagent by reaction with the analyte.

RECOIL. The motion acquired by a particle through a collision with, or the emission of, another particle or electromagnetic *radiation.* [1]

RELATIVE COUNTING. A measurement in which the *activity* of a test portion is derived from the ratio between the count rates observed for the test portion and for a *radioactive source* of known *activity* (adapted from ref. [1]).

RESONANCE ENERGY. The *energy* of a particle entering a nuclear reaction, this *energy* being just sufficiently high to lead to the formation of reaction products in one of their excited states [1].

RESONANCE INTEGRAL. The integral, over all or some specified portion of the *resonance energy* range, of the *cross section* divided by the *energy* of a *radiation*.

SATURATION. Of an irradiated element for a specified isotope, the steady state reached when the *disintegration rate* of the *nuclide* formed is equal to its production rate [1].

SATURATION ACTIVITY. For a specified *isotope*, the value of the *activity* of an irradiated element, when a state of *saturation* is reached [1].

SCAVENGING. In *radiation chemistry*: binding radicals or free electrons with a receptive (or reactive) material. In *radiochemistry*: the use of a precipitate to remove from solution by absorption or coprecipitation, a large fraction of one or more *radionuclides* [1].

SCINTILLATION. Burst of *luminescence* of short duration caused by an individual energetic particle [1].

SCINTILLATION DETECTOR. A *radiation detector* using a medium in which a burst of *luminescence radiation*, produced along the path of an ionizing particle, is quantified.

SCINTILLATOR. The scintillating material intended to be the component sensitive to radiation, absorbed directly or via the solvent, in a *scintillation detector*.

SELF-ABSORPTION. The absorption of *radiation* by the emitting *source*.

SELF-ABSORPTION FACTOR. Of a *radiation source*, the ratio between the quantity of the *radiation* emitted by the *source* and the quantity of the *radiation* as produced by the *radioactive* nuclei present in the *source*. Synonymous with: *source* efficiency.

SELF-SHIELDING. The lowering of the *flux density* in the inner part of an object due to absorption in its outer layers [1].

SEMICONDUCTOR DETECTOR. A *radiation detector* using a semiconductor, in which free electric charges are produced along the path of an ionizing particle, in combination with a high voltage and electrodes to collect the induced electric charges.

SEPARATION, RADIOCHEMICAL. Separation by a chemical means of the *radioactive isotopes* of a specific element from a mixture of *radionuclides*.

SOURCE, RADIOACTIVE. Any quantity of *radioactive* material which is intended for use as a source of *ionizing radiation*.

SZILARD-CHALMERS EFFECT. The rupture of the chemical bond between an atom and the molecule of which the atom is a part, as a result of a nuclear reaction of that atom [1].

TRACER. Labelled members of a population used to measure certain properties of that population [1].

TRACER, ISOTOPIC. A *tracer* which only differs in isotopic composition from the substance to be traced [1].

TRACER, GENERALLY LABELLED. A *tracer* in which the position of the *label* is not defined.

TRACER, NOMINALLY LABELLED. A *tracer* in which the *label* is present mainly in a specified position.

TRACER, SPECIFICALLY LABELLED. A *tracer* in which the *label* is present in a specified position.

TRACER, STEREOSPECIFICALLY LABELLED. A *tracer* in which the *label* is present in a stereospecific position.

TRACER, UNIFORMLY LABELLED. A *tracer* in which the *label* is uniformly distributed over its possible positions.

X-RADIATION, CHARACTERISTIC. X-radiation consisting of discrete wavelengths which are characteristic for the emitting element [1].

X-RAY EMISSION ANALYSIS, PARTICLE INDUCED. A kind of analysis based on the measurement of the *energies* and intensities of *characteristic X-radiation* emitted by a test portion during *irradiation* with charged particles other than electrons.

X-RAY EMISSION ANALYSIS, RADIOISOTOPE INDUCED. A kind of analysis based on the measurement of the *energies* and intensities of *characteristic X-radiation* emitted by a test portion during *irradiation* with a *radioactive source.*

X-RAY FLUORESCENCE. The emission of *characteristic X-radiation* by an atom as a result of the interaction of electromagnetic *radiation* with its orbital electrons.

X-RAY FLUORESCENCE ANALYSIS. A kind of analysis based on the measurement of the energies and intensities of *characteristic X-radiation* emitted by a test portion during *irradiation* with electromagnetic radiation.

X-RAY FLUORESCENCE ANALYSIS, ENERGY-DISPERSIVE. A kind of *X-ray fluorescence analysis* involving the measurement of the *energy* spectrum of the emitted *radiation* [1], e.g. by a *semiconductor detector.*

X-RAY FLUORESCENCE ANALYSIS, WAVELENGTH-DISPERSIVE. A kind of *X-ray fluorescence analysis* involving the measurement of the wavelength spectrum of the emitted *radiation* [1] e.g. by using a diffraction grating or crystal.

YIELD, FLUORESCENCE. For a given transition from an excited state of a specified atom, the ratio of the number of excited atoms which emit a photon to the total number of excited atoms.

YIELD, RADIOCHEMICAL. The yield of a *radiochemical separation* expressed as a fraction of the *activity* originally present.

REFERENCE

[1] M. de Bruin: "Glossary of terms used in nuclear analytical chemistry", Pure Appl. Chem., Vol. 54, No. 8 (1982) pp. 1533-1554