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Photocatalysis - Glossary of terms

Photokatalyse - Glossar der Begriffe

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

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Introduction

Photocatalysis is a very efficient advanced oxidation technique which enables the production of active species following light absorption by the photocatalyst, such as bound/free hydroxyl radicals (·OH), perhydroxyl radicals (·OOH), conduction band electrons and valence band holes, capable of partly or completely mineralising/oxidising the majority of organic compounds. The most commonly used photocatalyst is titanium dioxide (TiO_2), the latter being thermodynamically stable, non-toxic and economical. It can be used in powder form or deposited on a substrate (glass fibre, fabrics, plates/sheets, etc.). The objective is to introduce performance standards for photo-induced effects (including photocatalysis). These standards will mainly concern test and analysis methods.

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Persons using this document should be familiar with the normal laboratory practice, if applicable. This document cannot address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any regulatory conditions.

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1 Scope

A common language for standards, disclosed to a wide audience and referring only to the operational protocols and to their outcomes, is needed both for a consistent set of standards and the connection with the scientific literature. This glossary will take into account existing glossary of terms used in *photocatalysis* and *photochemistry*. Because in *photocatalysis* numerous properties are difficult to be evaluated, it is strongly recommended in standard norms to avoid reporting properties depending on number of actives sites, the mechanisms of adsorption or kinetic mechanisms of photocatalytic reactions. For the same reason instead of the *quantum yield* and related quantities it is easier to report the *photonic efficiency*.

Most of the definitions reported in this Technical Specification are a sub-set of the IUPAC definitions in *photocatalysis* and radiocatalysis [1]. Some other definitions, in particular for the *photocatalytic rate* and reactors are taken from a dedicated work [2]. The use and many technical specifications on the physical values suggested for irradiation conditions in the standards are reported in a separate Technical Specification [3].

The arrangement of entries is alphabetical, and the criterion adopted by the IUPAC has been followed for the typeface used: *italicized words* in a definition or following it indicate a cross-reference in the Glossary.

2 Generalities

2.1 Note on units

SI units are adopted, with some exceptions, prominently in the use of the *molar decadic absorption coefficient*, ε, with common units $dm^3\ mol^{-1}\ cm^{-1}$ and a mole of photons denoted as an *einstein*. Note that “amount concentration” is the preferred term for what has been known as “molar concentration”, and is complementary to the terms “mass concentration” and “number concentration”.

2.2 Note on symbols

Functional dependence of a physical quantity f on a variable x is indicated by placing the variable in parentheses following the symbol for the function; e.g., $\varepsilon(\lambda)$. Differentiation of a physical quantity f with respect to a variable x is indicated by a subscript x; e.g., the typical *spectral radiant power* quantity $P_\lambda = dP/d\lambda$. The natural logarithm is indicated with *ln*, and the logarithm to base 10 with *log*.

For the magnitudes implying energy or photons incident on a surface from all directions, the set of symbols recommended by the International Organization for Standardization (ISO) [4] and included in the IUPAC "Green Book", and by the International Commission on Illumination [5] are adopted, i.e., H_o or F_o for *fluence*, E_o for *fluence rate*, $H_{p,o}$ or $F_{p,o}$ for *photon fluence*, and $E_{p,o}$ for *photon fluence rate*, note the letter o as subscript. This has been done primarily to comply with internationally agreed-upon symbols. It is important, however, to avoid confusion with the terms used to designate an amount of energy (or photons) prior to *absorption*. In these cases, the superscript 0 (zero) is used.

2.3 Note on the relationship between spectral, radiometric, and photonic quantities

When a quantity expressed in photonic units (G_p) covers a *wavelength* range (polychromatic irradiation between λ_1 and λ_2), then G_p is the integral between λ_1 and λ_2 of the corresponding spectral photonic quantity, $G_p(\lambda)$:

$$G_p = \int_{\lambda 1}^{\lambda 2} G_p(\lambda)\, d\lambda$$ (e.g., *spectral photon flux*).