United Kingdom of Great Britain and Northern Ireland

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BS PAS 131 (2007) (English): Terminology for medical, health and personal care applications of nanotechnology

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PAS 131:2007

PUBLICLY AVAILABLE SPECIFICATION

Terminology for medical, health and personal care applications of nanotechnology

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Contents

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Foreword

Publishing information

This Publicly Available Specification (PAS) has been commissioned by the UK Department for Innovation, Universities and Skills (DIUS) and developed through the British Standards Institution (BSI). It came into effect on 31 December 2007.

Acknowledgement is given to the following organizations that were involved in the development of this terminology:

- Institute of Nanotechnology;
- Medwise International Consultancy;
- Queen Mary, University of London;
- The British Healthcare Trades Association;
- Smith and Nephew.

In addition, acknowledgement is given to the contributions of those that commented, including BSI Technical Committee NTI/1, *Nanotechnologies*, the working groups of ISO Technical Committee ISO/TC 229, *Nanotechnologies*, and other organizations and experts.

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The PAS process enables a specification to be rapidly developed in order to fulfil an immediate need in industry. A PAS may be considered for further development as a British Standard, or constitute part of the UK input into the development of a European or International Standard.

Relationship with other publications

This PAS is issued as part of a suite of nanotechnology terminology PASs:

- PAS 71, *Vocabulary – Nanoparticles*;
- PAS 131, *Terminology for medical, health and personal care applications of nanotechnologies*;
- PAS 132, *Terminology for the bio-nano interface*;
- PAS 133, *Terminology for nanoscale measurement and instrumentation*;
- PAS 134, *Terminology for carbon nanostructures*;
- PAS 135, *Terminology for nanofabrication*;
- PAS 136, *Terminology for nanomaterials*.

PAS 131 to PAS 136 include terms the definitions for which differ to those given in PAS 71:2005, which was published a few years earlier. These differences are the result of further reflection and debate and reflect consensus within the PAS steering groups. Until PAS 71:2005 can be revised to incorporate these changes, it is intended that the terms in PAS 131 to PAS 136 take precedence over PAS 71:2005.

This suite of PASs acknowledges the standards development work being conducted by BSI Technical Committee NTI/1, *Nanotechnologies*, ISO TC/229, *Nanotechnologies*, IEC/TC 113, *Nanotechnology standardization for electrical and electronic products and systems*, and CEN/TC 352, *Nanotechnologies*. Attempts have been made to align the definitions in these PASs with the definitions being developed by these committees, particularly the draft ISO/TS 27687, *Terminology and definitions for nanoparticles*. However, as the work of these committees is at a development stage, complete alignment has not been possible in every instance.

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This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Introduction

Many authorities predict that applications of nanotechnologies will ultimately pervade virtually every aspect of life and will enable dramatic advances to be realized in most areas of communication, health, manufacturing, materials and knowledge-based technologies. Even if this is only partially true, there is an obvious need to provide industry and research with suitable tools to assist the development, application and communication of the technologies. One essential tool in this armoury will be the harmonization of the terminology and definitions used in order to promote their common understanding and consistent usage.

This terminology includes terms that are either specific to the sector covered by the title or are used with a specific meaning in the field of nanotechnology. It is one of a series of terminology PASs covering many different aspects of nanotechnologies.

This terminology attempts not to include terms that are used in a manner consistent with a definition given in the *Oxford English Dictionary* [1], and terms that already have well established meanings and to which the addition of the prefix "nano" changes only the scale to which they apply but does not otherwise change their meaning.

The multidisciplinary nature of nanotechnologies can lead to confusion as to the precise meaning of some terms because of differences in usage between disciplines. Users are advised that, in order to support the standardization of terminology, this PAS provides single definitions wherever possible.

1 Scope

This Publicly Available Specification (PAS) lists terms and definitions used in or associated with naming or describing applications of nanotechnologies and nanomaterials for medicinal products, medical devices, cosmetics, sunscreens and other personal care products.

This PAS is intended for use by technologists, regulators, non-governmental organizations (NGOs), consumer organizations, members of the public and others with an interest in the medical, health and personal care applications of nanotechnology.

2 General

2.1 active nanostructure
nanostructure that achieves its intended function by virtue of a change of state during application and/or in response to an external or endogenous influence, or which has a direct influence on the system to which it is applied

2.2 nanobiotechnology
use of biological components and/or construction principles for the design, characterization, production and application of structures, devices and systems in the **nanoscale**

2.3 nanocosmetic
cosmetic produced incorporating or utilizing **nanomaterials** and/or **nanotechnology**

2.4 nanofluidics
study and development of fluid flow in and through **engineered nanostructures**

2.5 nanointervention
manipulation at the cellular and subcellular level using **nanoscale** properties of materials or systems

2.6 nanomaterial
material with one or more external dimensions in the **nanoscale** or which is **nanostructured**

NOTE ***Nanomaterials*** *can exhibit properties that differ from those of the same material without* ***nanoscale*** *features.*

2.7 nanomedicine
application of **nanotechnology** to achieve advances in healthcare by exploiting the physical, chemical and biological properties of materials operating in the **nanoscale**

NOTE Nanomedicine has the potential to enable early detection and prevention, and to essentially improve diagnosis, treatment and follow-up of diseases.

[derived from the European Technology Platform for Nanotechnology [2]]

2.8 nano-object
discrete piece of material with one or more external dimensions in the **nanoscale**

NOTE This is a generic term for all ***nanoscale*** *objects.*

[ISO/TS 27687[1)]]

2.9 nanoparticle
nano-object with all three external dimensions in the **nanoscale**

NOTE If the lengths of the longest and the shortest axes of the ***nano-object*** *differ significantly (typically by more than three times) the terms* ***nanorod*** *or* ***nanoplate*** *are intended to be used instead of the term nanoparticle.*

[ISO/TS 27687[1)]]

2.10 nanopharmaceutical
medicinal preparation making use of material properties in the **nanoscale**

NOTE 1 This is sometimes colloquially known as a nanoceutical.

NOTE 2 An example includes ***nanoparticles*** *for drug delivery applications.*

[derived from the Nanodictionary [3]]

[1)] In preparation.

2.11 nanoscale
size range from approximately 1 nm to 100 nm

NOTE 1 Properties that are not extrapolations from larger size will typically, but not exclusively, be exhibited in this size range.

*NOTE 2 The lower limit in this definition (approximately 1 nm) has no physical significance but is introduced to avoid single and small groups of atoms from being designated as **nano-objects** or elements of **nanostructures**, which might be implied by the absence of a lower limit.*

[ISO/TS 27687[2)]]

2.12 nanoscience
study of phenomena, novel characteristics and manipulation of materials in the **nanoscale**

2.13 nanostructure
nanoscale structure

*NOTE Also see definitions of **active nanostructure** and **passive nanostructure**.*

2.14 nanostructured
possessing a structure comprising contiguous elements with one or more dimension in the **nanoscale** but excluding any primary atomic or molecular structure

NOTE 1 An example of a primary atomic or molecular structure is the arrangement of atoms in a crystalline solid.

*NOTE 2 The use of the term contiguous implies that a sphere of approximately 100 nm diameter, inscribed in a **nanostructured** material, will intersect more than one element of the structure.*

2.15 nanotechnology
design, characterization, production and application of structures, devices and systems by controlling shape and size in the **nanoscale**

[derived from *Nanoscience and nanotechnologies* [4]]

2.16 passive nanostructure
nanostructure that achieves its intended function through stable behaviour or properties

NOTE 1 Passive nanostructures show morphological stability and stability of their chemical, physical or biological properties.

NOTE 2 Changes in state can be morphological, chemical, physical or biological.

3 Molecular entities

3.1 fullerene
closed-cage structure having more than 20 carbon atoms consisting entirely of three-coordinate carbon atoms

NOTE A fullerene with 60 carbon atoms (C_{60}) is sometimes called buckminsterfullerene.

[*J. Chem. Inf. Comp. Sci.*, 35, 969-978 [5]]

3.2 graphene
single sheet of trigonally bonded (sp^2) carbon atoms in a hexagonal structure

2) In preparation.

4 Structural entities

4.1 acicular structure
needle shaped structure

4.2 agglomerate
collection of loosely bound particles or **aggregates** or mixtures of the two where the resulting external surface area is similar to the sum of the surface areas of the individual components

NOTE The forces holding an agglomerate together are weak forces, for example van der Waals forces, as well as simple physical entanglement.

[ISO/TS 27687[3)]]

4.3 aggregate
particle comprising strongly bonded or fused particles where the resulting external surface area may be significantly smaller than the sum of calculated surface areas of the individual components

NOTE The forces holding an aggregate together are strong forces, for example covalent bonds, or those resulting from sintering or complex physical entanglement.

[ISO/TS 27687[3)]]

4.4 carbon nanotube
nanotube consisting of carbon

*NOTE This term is commonly used to refer to a seamless tube constructed from **graphene** that can be either a single-wall carbon nanotube (SWCNT), comprising a single layer of carbon atoms, or a multi-wall carbon nanotube (MWCNT), comprising multiple concentric tubes.*

4.5 dendrimer
repeatedly branched macromolecule

NOTE Dendrimers can be configured as a sphere, partial sphere or wedge structure (i.e. dendritic wedge).

4.6 dendritic particle
particle with a highly branched structure on its surface and/or in its core

NOTE Also referred to as a branched-chain aggregate.

[derived from PAS 71:2005, definition **3.6**]

4.7 dendron
dendrimer containing a single chemically addressable group

NOTE The single chemically addressable group is known as the focal point.

4.8 engineered nanoparticles
nanoparticles deliberately designed and produced to have specific properties or a specific composition

[derived from PAS 71:2005, definition **3.7**]

4.9 liposome
polymeric **nanoparticle** with various targeting ligands attached to its surface

NOTE The functionality of liposomes means that they can attach to surfaces and accumulate in pathological areas for treatment of disease.

3) In preparation.

4.10 micelle
aggregation of surfactant molecules dispersed in a liquid

NOTE 1 The surfactant molecules are often sequestered into hydrophilic and hydrophobic regions.

NOTE 2 Micelles are commonly spherical but can also be branched, rods or worm-like.

4.11 nanocluster
non covalently or covalently bound group of atoms or molecules whose largest overall dimension is in the **nanoscale**

4.12 nanocore
nanoscale central part of a structure encapsulated (or coated) in a dissimilar material

4.13 nanocrystal
nanoscale solid formed with a periodic lattice of atoms, ions or molecules

[PAS 71:2005, definition **3.15**]

4.14 nanofibre
flexible **nanorod**

[ISO/TS 27687[4)]]

4.15 nanohorn
nanoscale cone

[PAS 71:2005, definition **3.18**]

4.16 nanoplate
nano-object with one external dimension in the **nanoscale** and the two other external dimensions significantly larger

NOTE 1 The smallest external dimension is the thickness of the nanoplate.

*NOTE 2 The two significantly larger dimensions are considered to differ from the **nanoscale** dimension by more than three times.*

*NOTE 3 The larger external dimensions are not necessarily at the **nanoscale**.*

[ISO/TS 27687[4)]]

4.17 nanopowder
mass of dry **nanoparticles**

4.18 nanoribbon
nanorod flattened in one of its shorter dimensions

NOTE Also referred to as a nanobelt.

4) In preparation.

4.19 nanorod
nano-object with two similar external dimensions in the **nanoscale** and the third dimension significantly larger than the other two external dimensions

*NOTE 1 The largest external dimension is the length of the nanorod and is not necessarily in the **nanoscale**.*

NOTE 2 The two similar external dimensions are considered to differ in size by less than three times and the significantly larger external dimension is considered to differ from the other two by more than three times.

NOTE 3 A nanorod can take any cross-sectional shape consistent with the dimensional limits of the definition.

[ISO/TS 27687[5)]]

4.20 nanorope
nanofibres in a twisted conformation

4.21 nanoshell
hollow nanoparticle

NOTE This is typically used as a delivery vehicle.

[Nanodictionary [3]]

4.22 nanosome
liposome designed at the **nanoscale**

*NOTE **Nanosomes** are also known as nanoscale liposomes and nanocapsules.*

4.23 nanotube
hollow **nanorod**

[ISO/TS 27687[5)]]

4.24 nanowire
elongated structure with only two dimensions in the **nanoscale** and with properties that allow for the transmission of energy

4.25 primary particle
smallest identifiable subdivision in a particulate system

[*Particle Size Characterization* [6] and *The Use of Nomenclature in Dispersion Science and Technology* [7]]

4.26 quantum dot
discrete **nanoscale** semiconductor or metal structure that exhibits size-dependent electronic and optical properties due to quantum confinement

[derived from *Occupational Ultrafine Aerosol Exposure Characterization and Assessment* [8]]

4.27 stealth liposome
liposome that has been specifically designed to avoid detection by the body's immune system

NOTE 1 Stealth liposomes are particularly designed to avoid detection within the reticuloendothelial system.

NOTE 2 Detection avoidance is commonly achieved by the studding of the outside of the membrane with polyethylene glycol (PEGylation) which is inert in the body and so permits a longer circulation for drug delivery.

[5)] In preparation.

5 Nanosystems

5.1 nanoarray
multiple array of **nanoscale** features organized within a two-dimensional geometry

NOTE A nanoarray can be used for sensing or capturing biomolecules and cells.

5.2 nanochip
integrated electronic, photonic or fluidic system with features in the **nanoscale**

5.3 nanocomposite
multiphase structure in which at least one of the phases has at least one dimension in the **nanoscale**

[derived from *Pure and Applied Chemistry*, pp. 1985–2007 [9]]

5.4 nanodevice
coherent and functional entity for sensing, structural replacement, diagnosis and/or actuation that is in the **nanoscale** or that incorporates **nanostructures** or **nanosystems**

5.5 nanophase
discrete phase, within a material, which has at least one dimension in the **nanoscale**

[derived from PAS 71:2005, definition **5.10**]

5.6 nanosystem
integration of **passive nanostructures** and/or **active nanostructures** into a system by means of **nanotechnology**

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For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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[9] IUPAC, *Pure and Applied Chemistry*, Vol. 74, Issue 9.

Further reading

PAS 130, *Guidance on the labelling of manufactured nanoparticles and products containing manufactured nanoparticles*

PD 6699-1, *Nanotechnologies – Part 1: Good practice guide for specifying manufactured nanomaterials*

PD 6699-2, *Nanotechnologies – Part 2: Guide to safe handling and disposal of manufactured nanomaterials*

6) In preparation.

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