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Nanotechnologies — Vocabulary — Part 2: Nano-objects

*Nanotechnologies — Vocabulaire —
Partie 2: Nano-objets*



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committees responsible for this document are ISO/TC 229, *Nanotechnologies* and Technical Committee IEC/TC 113, *Nanotechnology standardization for electrical and electronic products and systems*. The draft was circulated for voting to the national bodies of both ISO and IEC.

This first edition of ISO/TS 80004-2 cancels and replaces ISO/TS 27687:2008, which has been technically revised.

Documents in the 80000 to 89999 range of reference numbers are developed by collaboration between ISO and IEC.

ISO/TS 80004 consists of the following parts, under the general title *Nanotechnologies — Vocabulary*:

- *Part 1: Core terms*
- *Part 2: Nano-objects*
- *Part 3: Carbon nano-objects*
- *Part 4: Nanostructured materials*
- *Part 5: Nano/bio interface*
- *Part 6: Nano-object characterization*
- *Part 7: Diagnostics and therapeutics for healthcare*
- *Part 8: Nanomanufacturing processes*

The following parts are under preparation:

- *Part 9: Nano-enabled electrotechnical products and systems*
- *Part 10: Nano-enabled photonic components and systems*
- *Part 11: Nanolayer, nanocoating, nanofilm, and related terms*

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- *Part 12: Quantum phenomena in nanotechnology*
- *Part 13: Graphene and other two-dimensional materials*

Introduction

It is predicted that applications of nanotechnologies may pervade all areas of life. In the areas of communication, health, manufacturing, materials and knowledge-based technologies, there is a need to provide industry and research with standardized vocabulary and nomenclature to aid the responsible development and application of the technologies. It is also essential that regulators such as health and environmental protection agencies have reliable measurement systems supported by well-founded and robust standards.

Often in the field of nanotechnologies, naming of materials seen on microscopic images is inspired by the shape of objects found in everyday life, although the physical size is much smaller. The prefix nano- is often added to denote the small size of the object. (The prefix nano- is also used in SI units to indicate 10^{-9} e.g. 1 nanometre = 10^{-9} metre.). Thus, the term “*nanoscale*” (2.1) has been defined to denote the length interval approximately from 1 nm to 100 nm.

To create a unitary vocabulary, this part of ISO 80004 encompasses terms used concerning particles with nanoscale dimensions. The terms in this part of ISO 80004 form part of a larger hierarchy of terms under development for nanotechnologies. These terms are intended to facilitate communications between organizations and individuals in industry and those who interact with them.

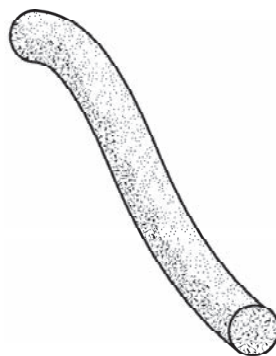
Objects with one or more external dimensions in the nanoscale can have properties that make them key components of materials and systems resulting in improved performance over their conventional counterparts. These *nano-objects* (2.2) often have properties that are not simple extrapolations of the properties of their larger form, with these novel properties called emerging, discontinuous or transformative properties.

The size and shape of nano-objects are often intrinsic to their function, so the description and measurement of their size and shape are important and must be considered carefully. The three most basic shapes referred to in this part of ISO 80004 are illustrated in Figure 1. These three simple shapes represent the main classes of structural dimensionality to help categorize nano-objects. Some other common shapes are defined in this part of ISO 80004, but a large number of different shapes are possible.

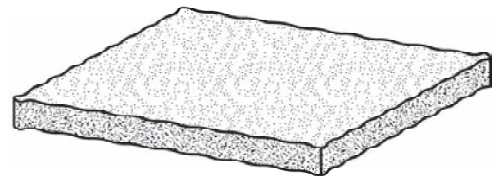
A number of other parameters in addition to size and shape are also intrinsic to the function and phenomena exhibited by nano-objects. These parameters include composition, morphology, crystalline structure, and surface features, which can all have a major influence on the key nanoscale phenomena exhibited by nano-objects. Such phenomena include magnetic, optical, catalytic, electronic, and other properties.



a) nanoparticle
(3 ext. dimensions
in the nanoscale)



b) nanofibre
(2 ext. dimensions
in the nanoscale)



c) nanoplate
(1 ext. dimensions
in the nanoscale)

Figure 1 — Schematic diagrams showing some shapes for nano-objects

A particular issue concerns nano-objects where one or more external dimensions are larger than the nanoscale. Potential confusion can occur when one of these dimensions greatly exceeds the nanoscale. For example, carbon nanotubes can have overall lengths in the millimetre range and are still nano-

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objects according to the definitions in this part of ISO 80004. An example of an approach to this issue is to consider the size or shape at which the health risk from inhalation or other potential routes of exposure to nano-objects becomes small as an upper size limit for nano-objects.

It is acknowledged that a wide variety of approaches to definitions and classifications are applicable to particulate material and some of these regimes may also be relevant to nano-objects. Industrial, regulatory, and scientific domains often use terms such as coarse, fine and ultrafine to denote different size range fractions of *particles* (3.1). Thus for airborne particles, ultrafine particles, specified as PM_{0.1} (PM means “particulate matter”), refer to particles with aerodynamic diameters of 100 nm or less. Fine particles (PM_{2.5}) refer to particles with aerodynamic diameters of 2,5 µm or less and coarse particles (PM₁₀) refer to those with aerodynamic diameters of 10 µm or less. These size range fractions are used by regulators for risk assessment purposes in many contexts, including traffic pollution, volcanic ash, dust storms, industrial pollution and natural airborne allergens such as pollen.

In this Technical Specification, nano-objects are defined according to their shape as determined by nanoscale dimensionality. In addition, some types of nano-objects are also defined according to structural configuration, morphology, form or functionality. It is beyond the scope of this Technical Specification to consider or recommend specific size, size distribution, or related thresholds for nano-objects, particularly given the wide variability in size, shape, morphology, composition, and surface features of nano-objects, with each combination potentially presenting differing implications for assessments of risk or safety to health or the environment.

There is a hierarchical relationship between many of the different terms in this part of ISO 80004. Elements of this are shown in [Figure 2](#) to illustrate some of the relationships that exist.

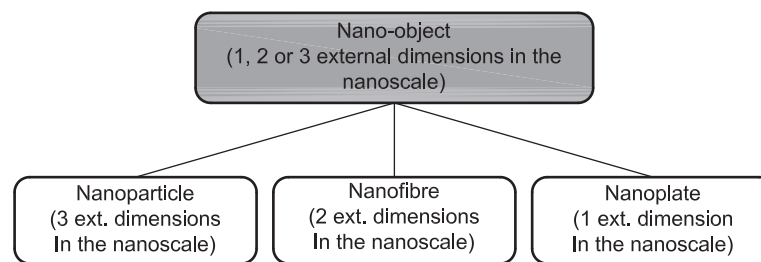


Figure 2 — Fragment of hierarchy of terms related to nano-objects