
**Nanotechnologies — Terminology and
definitions for nano-objects —
Nanoparticle, nanofibre and nanoplate**

*Nanotechnologies — Terminologie et définitions relatives
aux nano-objets — Nanoparticule, nanofibre et nanoplat*

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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
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In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of document:

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Introduction

As many authorities predict that applications of nanotechnologies will pervade all areas of life and will enable dramatic advances to be realized in all areas of communication, health, manufacturing, materials and knowledge-based technologies, there is an obvious need to provide industry and research with suitable tools to aid the development and application of those technologies. It is also essential that regulators and health and environmental protection agencies have available reliable measurement systems and evaluation protocols supported by well-founded and robust standards.

Often in the field of nanotechnologies, researchers with the aid of microscopes name materials 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 S.I. units to indicate 10^{-9} e.g. 1 nanometre = 10^{-9} metre.)

To create a unitary standard, this terminology and definitions document encompasses terms used in both nanosciences and nanotechnologies concerning particles at the nano-scale. Nano-object and other new terms are coined to allow development of a rational hierarchical system of definitions. This hierarchy will allow systematic building of vocabulary and is contained in a larger hierarchy of terms under development for nanotechnologies. This document provides an up-to-date listing of terms and definitions relevant to the area. It forms one part of a projected multi-part terminology and definitions document covering the different aspects of nanotechnologies. It is intended to facilitate communications between organizations and individuals in industry and those who interact with them.

This document is concerned with the definition of terminology and definitions for these small objects. These objects come in several shapes; the three basic shapes referred to in this document are illustrated in Figure 1:

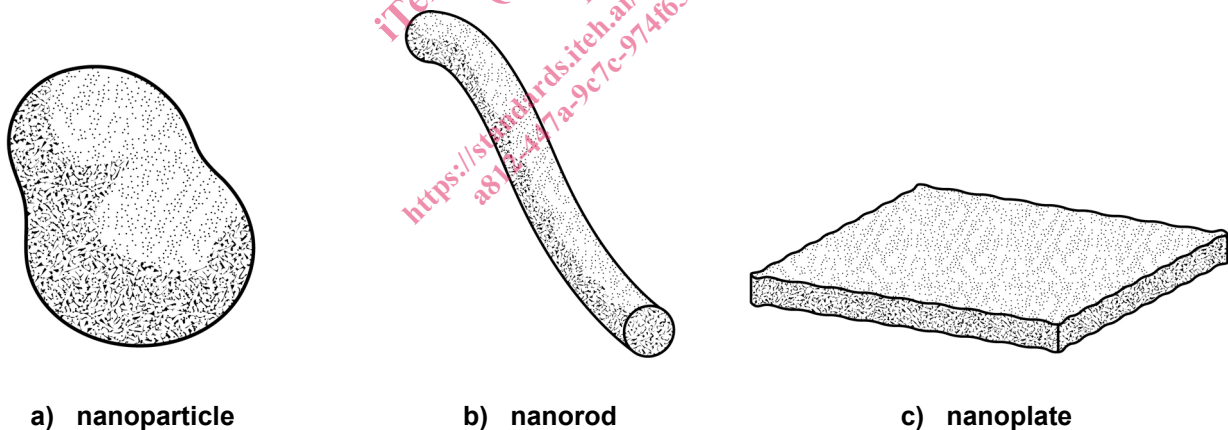


Figure 1 — Schematic diagrams showing some shapes for nano-objects

There is a hierarchical relationship between many of the different terms in the document. Some elements of this are shown in Figure 2 to illustrate some of the relationships that exist.

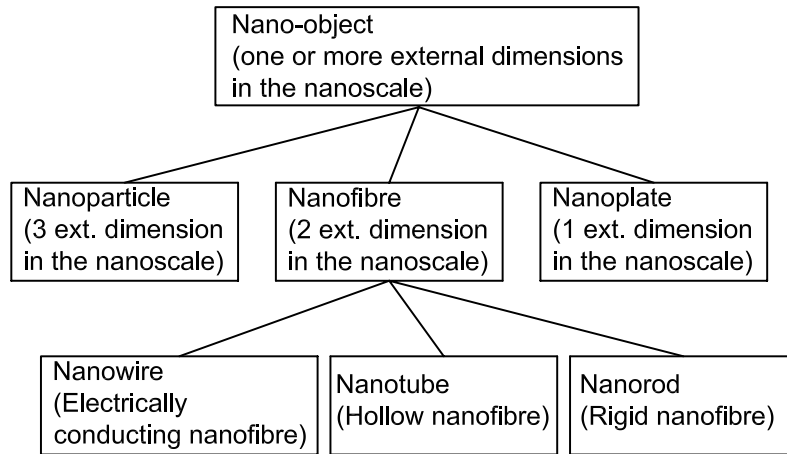


Figure 2 — Fragment of hierarchy of terms related to nano-objects

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Nanotechnologies — Terminology and definitions for nano-objects — Nanoparticle, nanofibre and nanoplate

1 Scope

This Technical Specification lists terms and definitions related to particles in the field of nanotechnologies. It is intended to facilitate communications between organizations and individuals in industry and those who interact with them.

2 Core terms related to particles

2.1

nanoscale

size range from approximately 1 nm to 100 nm

NOTE 1 Properties that are not extrapolations from a larger size will typically, but not exclusively, be exhibited in this size range. For such properties the size limits are considered approximate.

NOTE 2 The lower limit in this definition (approximately 1 nm) 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.

2.2

nano-object

material with one, two or three external dimensions in the **nanoscale**

NOTE Generic term for all discrete **nanoscale** objects.

3 Terms concerning particles and assemblies of particles

Nano-objects (for example nanoparticles, nanofibres, and nanoplates see Clause 4), often occur in (large) groups, rather than isolated. For reasons of surface energy, such coexisting nano-objects are likely to interact. In the description of these interactions, the following terms are often used. The following terms are not restricted with respect to physical size and shape. These terms are included for completeness and their importance at the nanoscale.

3.1

particle

minute piece of matter with defined physical boundaries

[ISO 14644-6:2007, definition 2.102]

NOTE 1 A physical boundary can also be described as an interface.

NOTE 2 A particle can move as a unit.

NOTE 3 This general particle definition applies to nano-objects.

3.2 agglomerate
collection of weakly 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 1 The forces holding an **agglomerate** together are weak forces, for example van der Waals forces, or simple physical entanglement.

NOTE 2 Agglomerates are also termed secondary **particles** and the original source particles are termed primary **particles**.

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

NOTE 2 **Aggregates** are also termed secondary **particles** and the original source **particles** are termed primary **particles**.

4 Terms specific to nano-objects

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

NOTE If the lengths of the longest to 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**.

4.2 nanoplate nano-object
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 in the **nanoscale**.

4.3 nanofibre nano-object
nanofibre
nano-object with two similar external dimensions in the **nanoscale** and the third dimension significantly larger

NOTE 1 A nanofibre can be flexible or rigid.

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 The largest external dimension is not necessarily in the **nanoscale**.

4.4 nanotube hollow nanofibre
nanotube
hollow **nanofibre**

4.5

nanorod

solid **nanofibre**

4.6

nanowire

electrically conducting or semi-conducting **nanofibre**

4.7

quantum dot

crystalline **nanoparticle** that exhibits size-dependent properties due to quantum confinement effects on the electronic states

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