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भाग 1 कोर शब्दावली
(पहला पुनरीक्षण)

Nanotechnologies — Vocabulary
Part 1 Core Terms
(First Revision)

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NATIONAL FOREWORD

This Indian standard (First Revision) is identical to ISO/TS 80004-1 : 2015 'Nanotechnologies — Vocabulary — Part 1: Core terms' issued by the International Organization for Standardization (ISO), was adopted by the Bureau of Indian Standards on the recommendation of the Nanotechnologies Sectional Committee and approval of the Metallurgical Engineering Division Council.

This standard was first published in 2013 as IS/ISO/TS 80004-1: 2010 under single numbering system. Later, some parts of ISO/TS 80004 series were adopted under dual numbering system of IS series IS 17003. Thus, the first revision of this standard has been undertaken to align with the latest version of ISO/TS 80004-1 : 2015 under dual numbering system to harmonize it with the latest developments that have taken place at international level.

Other parts in the series of ISO/TS 80004 which are adopted as Indian standards are:

<i>ISO No.</i>	<i>Subject</i>	<i>Corresponding Identical Indian Standard</i>
ISO/TS 80004-2 : 2015	Nanotechnologies — Vocabulary: Part 2 Nano-Objects	IS 17003 (Part 2) : 2018 ISO/TS 80004-2 : 2015
ISO/TS 80004-3 : 2020	Nanotechnologies — Vocabulary: Part 3 Carbon Nano - Objects	IS 17003 (Part 3) : 2022 ISO/TS 80004-3 : 2020
ISO/TS 80004-4 : 2011	Nanotechnologies — Vocabulary: Part 4 Nanostructured Materials	IS/ISO/TS 80004 (Part 4) : 2011
ISO/TS 80004-5 : 2011	Nanotechnologies — Vocabulary: Part 5 Nano bio interface	IS/ISO/TS 80004 (Part 5) : 2011
ISO/TS 80004-6 : 2013	Nanotechnologies — Vocabulary: Part 6 Nano - Object characterization	IS 17003 (Part 6) : 2018 ISO/TS 80004-6 : 2013
ISO/TS 80004-7 : 2011	Nanotechnologies — Vocabulary: Part 7 diagnostics and therapeutics for healthcare	IS/ISO/TS 80004 (Part 7) : 2011
ISO/TS 80004-8 : 2020	Nanotechnologies — Vocabulary: Part 8 Nano manufacturing process	IS 17003 (Part 8) : 2022 ISO/TS 80004-8 : 2020

The text of ISO standard has been approved as suitable for publication as in Indian Standard without deviations. Certain terminologies and conventions are, however, not identical with those used in Indian Standard. Attention is especially drawn to the following:

- Wherever the words 'International Standard' appear, referring to this standard, they should be read as 'Indian Standard'.
- Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

For the purpose of deciding whether a particular requirement of this standards is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'rules for rounding off numerical value (*second revision*)'.

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Introduction

By control of matter in the *nanoscale* (2.1), *nanotechnology* (2.3) brings together processes and techniques that are used to research, design and manufacture materials, devices, and systems. It enables management of characteristics such as material size, shape, morphology, chemical composition and molecular configuration for the improvement, or development of, new process and product properties.

Applications of nanotechnologies are expected to impact virtually every aspect of life and enable dramatic advances in communication, health, manufacturing, materials and knowledge-based technologies. Even if this is only partially realized, there is a need to provide industry and researchers with suitable tools to assist with the development, application and communication of nanotechnologies.

A crucial objective is the harmonization of terminology and definitions, in order to promote common understanding and consistent usage across communities where nanotechnologies are being developed and used. In the context of the ISO/TS 80004- series of standards, “terminology” refers to the following:

- a) a structured or conceptual presentation of vocabulary employed in nanotechnologies,
- b) assigned definitions for specific units of the language in this vocabulary.

This part of ISO/TS 80004 presents terminology and definitions for core terms in this emerging vocabulary, and serves as the foundation for a broader vocabulary constituted collectively by the ISO/TS 80004- series of standards.

As nanotechnologies continue to evolve, the terms and definitions to facilitate communications have become increasingly specific and precise. For many communities, the meaning of terms such as “nanoscale”, “*nanomaterial*” (2.4) and “nanotechnology” are inferred by logical application of the SI unit of scale. The prefix ‘nano-’ specifically means a measure of 10^{-9} units, and the nature of this unit is determined by the word that follows. In the ISO/TS 80004 vocabulary series, however, terms such as “*nano-object*” (2.5) and “nanoscale” employ size and geometric boundaries to express fundamental and measurable aspects of nanomaterials. In the case of the term *nanoscale*, the definition acknowledges that the length range of nano-objects might fall outside the precise boundaries normally associated with the concept of scale, by indicating that the upper and lower boundaries are approximate.

The lower limit (approximately 1 nm) in the definition of nanoscale is introduced to avoid single and small groups of atoms, as well as individual molecules, from being designated as nano-objects or elements of *nanostructures* (2.6), which might be implied by the absence of a lower limit. It should also be recognized that fullerene molecules and single layer planar structures (e.g. graphene) that have dimensions below 1 nm are, in practice, considered to be nanomaterials because they are important building blocks for nanotechnology.

Further, size-dependent biological effects, specifically particle-cell interactions, and environmental interactions related to nanotechnology, involve structures below 1 nm and above 100 nm. In addition to size, the complex interplay of parameters such as aspect ratio, core chemistry, agglomeration state, physical state, surface properties and others will influence biological and environmental interactions associated with nanostructured materials.

Terminology development is proceeding at an intensive pace and needs to be responsive to the needs of stakeholders. As knowledge expands, a robust terminology will need to effectively convey not only the size and shape-based metrics of nanomaterials but also the performance-based/properties-based aspects of intentionally produced nano-objects and nanostructured materials in their definitions.

It will be an on-going challenge to communicate complex concepts in definitions in a manner that is meaningful and practical for stakeholders in research, commercial applications, government and consumer communities. It is emphasized that the definition of “nanoscale” in the ISO/TS 80004 vocabulary series is a general descriptor serving to facilitate communication concerning nanotechnologies.

The development of core terms and their definitions has benefited from discussion over time concerning scientific, regulatory and consumer usage. The science is still emerging, as is the capacity to measure

and characterize nanomaterials, or more generally matter in the nanoscale. Care needs to be taken to ensure the latest scientific information is incorporated into the terminology as it becomes available. Since the inception of ISO/TC 229 and IEC/TC 113, nanotechnology has evolved and continues to evolve. It is important to acknowledge that the associated terms and their definitions will likewise follow an evolutionary path.

Many of the definitions in this part of ISO/TS 80004 are determined to be in harmony with a framework and hierarchical system of terminology for nanotechnologies. Furthermore, it is also important to recognize that articles fabricated to contain nanomaterials are not necessarily nanomaterials themselves.

[Figure 1](#) illustrates the relationships between “nanomaterial”, “nano-object” and “*nanostuctured material*” (2.7). However, this hierarchy is not intended to exclude the possibility for a nano-object to have internal or surface nanostructure. This figure should therefore be considered as schematic or idealized.

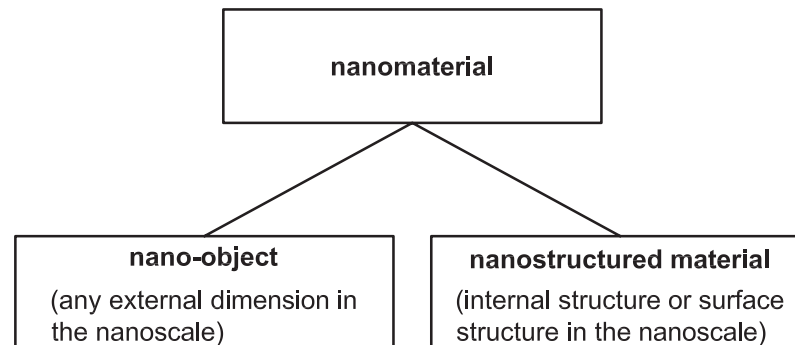


Figure 1 — Nanomaterial framework

Indian Standard
NANOTECHNOLOGIES — VOCABULARY
PART 1 CORE TERMS
(*First Revision*)

1 Scope

This part of ISO/TS 80004 lists terms and definitions related to core terms in the field of nanotechnologies. It is intended to facilitate communications between organizations and individuals in industry and those who interact with them.

2 Terms and definitions

2.1

nanoscale

length range approximately from 1 nm to 100 nm

Note 1 to entry: Properties that are not extrapolations from larger sizes are predominantly exhibited in this length range.

2.2

nanoscience

study, discovery and understanding of matter where size- and structure-dependent properties and phenomena manifest, predominantly in the *nanoscale* (2.1), distinct from those associated with individual atoms or molecules, or extrapolation from larger sizes of the same material

2.3

nanotechnology

application of scientific knowledge to manipulate and control matter predominantly in the *nanoscale* (2.1) to make use of size- and structure-dependent properties and phenomena distinct from those associated with individual atoms or molecules, or extrapolation from larger sizes of the same material

Note 1 to entry: Manipulation and control includes material synthesis.

2.4

nanomaterial

material with any external dimension in the *nanoscale* (2.1) or having internal structure or surface structure in the nanoscale

Note 1 to entry: This generic term is inclusive of *nano-object* (2.5) and *nanostructured material* (2.7).

Note 2 to entry: See also definitions 2.8 to 2.10.

2.5

nano-object

discrete piece of material with one, two or three external dimensions in the nanoscale (2.1)

Note 1 to entry: The second and third external dimensions are orthogonal to the first dimension and to each other.

2.6

nanostructure

composition of inter-related constituent parts in which one or more of those parts is a *nanoscale* (2.1) region

Note 1 to entry: A region is defined by a boundary representing a discontinuity in properties.

2.7

nanostuctured material

material having internal *nanostucture* (2.6) or surface nanostucture

Note 1 to entry: This definition does not exclude the possibility for a *nano-object* (2.5) to have internal structure or surface structure. If external dimension(s) are in the *nanoscale* (2.1), the term nano-object is recommended.

2.8

engineered nanomaterial

nanomaterial (2.4) designed for specific purpose or function

2.9

manufactured nanomaterial

nanomaterial (2.4) intentionally produced to have selected properties or composition

2.10

incidental nanomaterial

nanomaterial (2.4) generated as an unintentional by-product of a process

Note 1 to entry: The process includes manufacturing, bio-technological or other processes.

Note 2 to entry: See “ultrafine particle” in ISO/TR 27628:2007, 2.21

2.11

nanomanufacturing

intentional synthesis, generation or control of *nanomaterials* (2.4), or fabrication steps in the *nanoscale* (2.1), for commercial purposes

2.12

nanomanufacturing process

ensemble of activities to intentionally synthesize, generate or control *nanomaterials* (2.4), or fabrication steps in the *nanoscale* (2.1), for commercial purposes

2.13

nanoscale phenomenon

effect attributable to the presence of *nano-objects* (2.5) or *nanoscale* (2.1) regions

2.14

nanoscale property

characteristic of a *nano-object* (2.5) or *nanoscale* (2.1) region

2.15

nano-enabled

exhibiting function or performance only possible with *nanotechnology* (2.3)

2.16

nano-enhanced

exhibiting function or performance intensified or improved by *nanotechnology* (2.3)

Bibliography

- [1] ISO/TR 27628:2007, *Workplace atmospheres — Ultrafine, nanoparticle and nano-structured aerosols — Inhalation exposure characterization and assessment*
- [2] ISO/TS 80004-2:2015, *Nanotechnologies — Vocabulary — Part 2: Nano-objects*

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