PD IEC/TS 80004-9:2017

BSI Standards Publication

Nanotechnologies — Vocabulary

Part 9: Nano-enabled electrotechnical products and systems

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee NTI/1, Nanotechnologies.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Published by BSI Standards Limited 2017

ISBN 978 0 580 85138 4
ICS 07.120

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 28 February 2017.

Amendments/corrigenda issued since publication

Date	Text affected

IEC TS 80004-9

Edition 1.0 2017-01

TECHNICAL SPECIFICATION

Nanotechnologies – Vocabulary –
Part 9: Nano-enabled electrotechnical products and systems

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 07.120

ISBN 978-2-8322-3765-6

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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NANOTECHNOLOGIES – VOCABULARY –

Part 9: Nano-enabled electrotechnical products and systems

FOREWORD

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Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 80004-9, which is a Technical Specification, has been prepared by IEC technical committee 113: Nanotechnology for electrotechnical products and systems.

The text of this standard is based on the following documents:

Enquiry draft	Report on voting
113/315/DTS	113/335/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the 80004 Technical Specification, published under the general title *Nanotechnologies – Vocabulary*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- transformed into an International Standard,
- reconfirmed,
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- replaced by a revised edition, or
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A bilingual version of this publication may be issued at a later date.

INTRODUCTION

Nanotechnology advances have profound implications in all branches of engineering and science and have a noticeable impact on established industries by introducing technological innovation. Within the electrotechnical industry, nanotechnologies play an important role as regards the miniaturization and the integration of electronic components as well as the fabrication of electrical devices with novel functionalities and improved performances.

There is a substantial investment in research that will bring development and wide diffusion of new nanomaterials, devices and systems. Examples include nanoscale interconnects made with carbon nanotube bundles and graphene nanoribbons to replace copper and overcome physical and performance limits in integrated electronics. Carbon-based nanostructures are promising for nanoscale transistors in post-silicon electronics, enabling higher integration and faster switching speeds and lighting devices with more efficient and powerful electron emission. Nanoscale sensors and nano-electromechanical systems are also being widely investigated.

Recent progress in the synthesis of nanomaterials and composites with nanoscale phases offers real opportunities for application in electrochemical systems-technology to obtain, for example, more efficient and inexpensive fuel cells and nano-enabled lithium ion batteries with extended capacity. High energy storage capacity, reaching and exceeding that of modern batteries, is the target of new ultra-capacitors exploiting state-of-the-art nanotechnology. Developments in solar cells via nanostructures are intended to reduce costs as well as improve the conversion efficiency. The aforementioned products are just some electrotechnical examples that exploit nanotechnologies and are in rapid and constant evolution.

However, such a fast moving technology, as well as its high multidisciplinary nature, inevitably generates a multiplicity of new scientific and technical terms often with ambiguous definitions. The objective of this document is the compilation of a list of terms and definitions useful for persons operating in the field of nanotechnologies and in the production of electrotechnical products and systems.

NANOTECHNOLOGIES – VOCABULARY –

Part 9: Nano-enabled electrotechnical products and systems

1 Scope

This document specifies terms and definitions for electrotechnical products and systems reliant on nanomaterials for their essential functionalities. It is intended to facilitate communications between organizations and individuals in industry and those who interact with them.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

3.1 General terms related to nano-enabled electrotechnical products and systems

3.1.1
device
material element or assembly of such elements intended to perform a required function

Note 1 to entry: A device can form part of a larger device.

[SOURCE: IEC 60050-151:2001, 151-11-20]

3.1.2
molecular electronics
field of science and technology concerned with the design and fabrication of electronic devices using molecules as components

Note 1 to entry: Some molecules need to be functionalized in order to act as components.

[SOURCE: ISO/TS 80004-12:2016, 6.1]

3.1.3
nano-electromechanical system
NEMS
nanoscale device or embedded system involving one or more electronic and non-electronic components enabling the integration of electric and mechanical functionality of the system

Note 1 to entry: The components can be organic, inorganic or hybrid nanotechnology-based and function on the nanoscale for sensing, actuation, signal processing, display, or control of the interface.

Note 2 to entry: The components can be micro- or nano-machined to produce free surfaces and volumes which will be able to couple with the environment so that an electric transduction of a physical, optical, chemical, or biological phenomenon is produced.

3.1.4
nanoelectronics
field of science and technology concerned with the development and production of functional electronic devices with nanoscale components

[SOURCE: ISO/TS 80004-12:2016, 6.2]

3.1.5
nano-enabled device
device where the material elements or assembly of such elements exhibit performance or function only possible with nanotechnology

Note 1 to entry: The material is nanomaterial with any external dimension in the nanoscale or having internal structure or surface structure in the nanoscale.

Note 2 to entry: The function or performance exhibited is measurable and significant for the application of the nano-enabled device.

Note 3 to entry: Applications of nano-enabled device can include, but are not limited to, energy storage devices (capacitors, materials for lithium ion battery, fuel cell membrane, etc.), photovoltaic, organic electronics, and electro-optical devices.

3.1.6
nano-ink
formulation containing nanomaterials for use in printing

Note 1 to entry: Applications of nano-ink include printing semiconducting organic polymers or paper or plastic to create an electronically functional device.

3.1.7
nanomanipulator
high-precision device used for working with nanomaterial at the nanoscale

Note 1 to entry: In the field of electrotechnical products and systems, nanomanipulators can be used as in-situ electric probes.

3.1.8
nanoscale electric contact
nanoscale contact
electric contact connecting two or more objects with an interface having one or two dimensions in the nanoscale

3.1.9
nanoscale contact resistance
electric resistance associated with a nanoscale contact

3.1.10
nanoscale device
device where the material elements or assembly of such elements are in the nanoscale

Note 1 to entry: The material is nanomaterial with any external dimension in the nanoscale or having internal structure or surface structure in the nanoscale.

3.1.11
nanoscale electric interconnect
nanoscale interconnect
series of conductors or conductive materials connected together by nanoscale contacts that can pass electric energy

3.1.12
nano-subassembly
nano-enabled component of a product

3.1.13
nanowire
electrically conducting or semi-conducting nanofibre

[SOURCE: ISO/TS 80004-2:2015, 4.9]

3.1.14
single-electron transistor
transistor (IEV 521-04-46) where current transmitted can be controlled down to one electron

3.2 Terms related to nano-enabled photovoltaics and thin-film organic electronics

3.2.1
dye-sensitized photovoltaic cell
DSSC
essential part of a device in which the conversion of light into electrical energy is achieved by a photochemical system comprising a photo-sensitive anode and an electrolyte

Note 1 to entry: A dye-sensitized photovoltaic cell is a special type of photovoltaic nano-enabled device wherein the anode nanomaterial is stained by a photo sensitizer.

3.2.2
nanowire photovoltaic cell
essential part of a photovoltaic device with nanowires deposited or grown upward from a substrate, creating a surface that is able to absorb more sunlight than can a flat surface

3.2.3
organic electronics
OE
polymer electronics
plastics electronics
branch of electronics which uses organic materials for the fabrication of passive and active electronic components

3.2.4
organic and large area electronics
OLAE
branch of organic electronics with the potential to fabricate large (>> 1 mm^2) area electronic devices

Note 1 to entry: The electronic devices can also contain parts that are made with inorganic materials.

Note 2 to entry: The fabrication methods include vacuum processes as well as various methods of printing.

3.2.5
organic light emitting diode
OLED
light emitting diode in which light is emitted from organic materials

Note 1 to entry: An organic light emitting diode is a special type of nano-enabled light emitting diode based on small organic molecules or polymers.

[SOURCE: IEC 62341-1-2:2014, 2.2.25]

3.2.6
organic photovoltaic device
OPV
device in which the conversion of light into electric energy is achieved by organic materials

Note 1 to entry: An organic photovoltaic device is a special type of nano-enabled photovoltaic device based on small organic molecules or polymers acting as a donor/acceptor pair.

3.2.7
plasmonic photovoltaic cell
special type of photovoltaic device in which its optical properties are modified by incorporating metal nanoparticles to the semiconductor layer of the device

Note 1 to entry: The nanostructure of the metal nanoparticles increases the absorption and scattering of incident light and supports strong localized collective electron excitations known as surface plasmons.

Note 2 to entry: A plasmon resonance generating metallic nanostructure is provided on the semiconductor layer of the device for resonantly coupling light into the absorbing layer and transporting photo-induced charge carriers out of the absorbing layer, thereby improving the performance of the device.

3.2.8
quantum well photovoltaic cell
photovoltaic cell in which the photovoltaic effect occurs due to the presence of semiconductor quantum wells

3.2.9
quantum well
potential well which enables quantum confinement of particles in one dimension

Note 1 to entry: Sometimes, this term is used for more general conditions than one dimension.

[SOURCE: ISO/TS 80004-12:2016, 4.2]

3.3 Terms related to luminescent nanomaterials

3.3.1
luminescent nanomaterial
nanomaterial that can emit visible light by electric or optical excitation

Note 1 to entry: Luminescent nanomaterials include luminescent nano-objects and quantum dots.

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