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Nanotehnologije - Slovar - 8. del: Procesi nanoproizvodnje (ISO/TS 80004-8:2020)

Nanotechnologies - Vocabulary - Part 8: Nanomanufacturing processes (ISO/TS 80004-8:2020)

Nanotechnologien - Fachwörterverzeichnis - Teil 8: Industrieller Nanoherstellungsprozess (ISO/TS 80004-8:2020)

Nanotechnologies - Vocabulaire - Partie 8: Processus de nanofabrication (ISO/TS 80004-8:2020)

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English Version

Nanotechnologies - Vocabulary - Part 8: Nanomanufacturing processes (ISO/TS 80004-8:2020)

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (CEN ISO/TS 80004-8:2020) has been prepared by Technical Committee ISO/TC 229 "Nanotechnologies" in collaboration with Technical Committee CEN/TC 352 “Nanotechnologies” the secretariat of which is held by AFNOR.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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Endorsement notice

The text of ISO/TS 80004-8:2020 has been approved by CEN as CEN ISO/TS 80004-8:2020 without any modification.

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ISO/TS 80004-8

Second edition
2020-11

Nanotechnologies — Vocabulary —

Part 8: Nanomanufacturing processes

Nanotechnologies — Vocabulaire —

Partie 8: Processus de nanofabrication

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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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).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared jointly by Technical Committee ISO/TC 229, *Nanotechnologies*, and Technical Committee IEC/TC 113, *Nanotechnology for electrotechnical products and systems*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 352, *Nanotechnologies*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement). The draft was circulated for voting to the national bodies of both ISO and IEC.

This second edition cancels and replaces the first edition (ISO/TS 80004-8:2013), which has been technically revised throughout.

A list of all parts in the ISO/TS 80004 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Nanomanufacturing is the essential bridge between the discoveries of the nanosciences and real-world nanotechnology products.

Advancing nanotechnology from the laboratory into volume production ultimately requires careful study of manufacturing process issues including product design, reliability and quality, process design and control, shop floor operations, supply chain management, workplace safety and health practices during the production, use and handling of nanomaterials. Nanomanufacturing encompasses directed self-assembly and assembly techniques, synthetic methodologies, and fabrication processes such as lithography and biological processes. Nanomanufacturing also includes bottom-up directed assembly, top-down high-resolution processing, molecular systems engineering and hierarchical integration with larger scale systems. As dimensional scales of materials and molecular systems approach the nanoscale, the conventional rules governing their behaviour may change significantly. As such, the behaviour of a final product is enabled by the collective performance of its nanoscale building blocks.

Biological process terms are not included in this second edition of the nanomanufacturing vocabulary, but considering the rapid development of the field, it is expected that terms in this important area will be added in a future update to this document or in companion documents in the ISO/TS 80004 series. This could include both the processing of biological nanomaterials and the use of biological processes to manufacture materials at the nanoscale.

Similarly, additional terms from other developing areas of nanomanufacturing, including composite manufacturing, roll-to-roll manufacturing and others, will be included in future documents.

There is a distinction between the terms “nanomanufacturing” and “nanofabrication”. Nanomanufacturing encompasses a broader range of processes than does nanofabrication. Nanomanufacturing encompasses all nanofabrication techniques and also techniques associated with materials processing and chemical synthesis.

This document provides an introduction to processes used in the early stages of the nanomanufacturing value chain, namely the intentional synthesis, generation or control of nanomaterials, including fabrication steps in the nanoscale. The nanomaterials that result from these manufacturing processes are distributed in commerce where, for example, they may be further purified, be compatabilized to be dispersed in mixtures or composite matrices, or serve as integrated components of systems and devices. The nanomanufacturing value chain is, in actuality, a large and diverse group of commercial value chains that stretch across these sectors:

— the semiconductor industry (where the push to create smaller, faster, and more efficient microprocessors heralded the creation of circuitry less than 100 nm in size);

— electronics and telecommunications;

— aerospace, defence and national security;

— energy and automotive;

— plastics and ceramics;

— forest and paper products;

— food and food packaging;

— pharmaceuticals, biomedicine and biotechnology;

— environmental remediation;

— clothing and personal care.

There are thousands of tonnes of nanomaterials on the market with end-use applications in several of these sectors, such as carbon black and fumed silica. Nanomaterials that are rationally designed with

specific purpose are expected to radically change the landscape in areas such as biotechnology, water purification and energy development.

The majority of clauses in this document are organized by process type. In Clause 6, the logic of placement is as follows: in the step before the particle is made, the material itself is in a gas/liquid/solid phase. The phase of the substrate or carrier in the process does not drive the categorization of the process. As an example, consider iron particles that are catalysts in a process by which you seed oil with iron particles, the oil vaporizes and condenses forming carbon particles on the iron particles. What vaporizes is the oil, and therefore it is a gas phase process. Nanotubes grow from the gas phase, starting with catalyst particles that react with the gas phase to grow the nanotubes, thus this is characterized as a gas process. Indication of whether synthesis processes are used to manufacture nano-objects, nanoparticles or both is provided in Annex A.

In addition, Annex A identifies the processes that are also applicable to macroscopic materials and are therefore not exclusively relevant to nanomanufacturing. A common understanding of the terminology used in practical applications will enable communities of practice in nanomanufacturing and will advance nanomanufacturing strength worldwide. Extending the understanding of terms across the existing manufacturing infrastructure will serve to bridge the transition between the innovations of the research laboratory and the economic viability of nanotechnologies.

For informative terms supportive of nanomanufacturing terminology, see BSI PAS 135[11].

This document belongs to a multi-part vocabulary covering the different aspects of nanotechnologies.

Nanotechnologies — Vocabulary —

Part 8: Nanomanufacturing processes

1 Scope

This document defines terms related to nanomanufacturing processes in the field of nanotechnologies.

All the process terms in this document are relevant to nanomanufacturing, however, many of the listed processes are not exclusively relevant to the nanoscale. Terms that are not exclusive are noted within the definitions. Depending on controllable conditions, such processes can result in material features at the nanoscale or, alternatively, at larger scales.

There are many other terms that name tools, components, materials, systems control methods or metrology methods associated with nanomanufacturing that are beyond the scope of this document.

Terms and definitions from other parts of the ISO/TS 80004 series are reproduced in Clause 3 for context and better understanding.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
carbon nanotube
CNT
nanotube (3.9) composed of carbon

Note 1 to entry: Carbon nanotubes usually consist of curved graphene layers, including single-walled carbon nanotubes and multi-walled carbon nanotubes.

[SOURCE: ISO/TS 80004-3:2010, 4.3]

3.2
nanocomposite
solid comprising a mixture of two or more phase-separated materials, one or more being nanophase

Note 1 to entry: Gaseous nanophases are excluded (they are covered by nanoporous material).

Note 2 to entry: Materials with *nanoscale* (3.7) phases formed by precipitation alone are not considered to be nanocomposite materials.

[SOURCE: ISO/TS 80004-4:2011, 3.2]