ICS 07.100 PREDBEŽNÁ SLOVENSKÁ TECHNICKÁ NORMA Január 2025

STN P	**Nanotechnológie Slovník Časť 13: Grafén a príbuzné dvojrozmerné (2D) materiály (ISO/TS 80004-13: 2024)**	**STN P CEN ISO/TS 80004-13** 60 3030

Nanotechnologies - Vocabulary - Part 13: Graphene and other two-dimensional (2D) materials (ISO/TS 80004-13:2024)

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 12/24

Táto predbežná slovenská technická norma je určená na overenie. Prípadné pripomienky pošlite do septembra 2026 Úradu pre normalizáciu, metrológiu a skúšobníctvo Slovenskej republiky.

Obsahuje: CEN ISO/TS 80004-13:2024, ISO/TS 80004-13:2024

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English Version

Nanotechnologies - Vocabulary - Part 13: Graphene and other two-dimensional (2D) materials (ISO/DTS 80004-13:2024)

Nanotechnologies - Vocabulaire - Partie 13: Graphène et autres matériaux bidimensionnels (2D) (ISO/DTS 80004-13:2024)

Nanotechnologien - Fachwörterverzeichnis - Teil 13: Graphen und andere zweidimensionale (2D) Werkstoffe (ISO/DTS 80004-13:2024)

This Technical Specification (CEN/TS) was approved by CEN on 23 August 2024 for provisional application.

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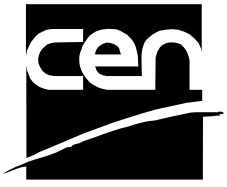

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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (CEN ISO/TS 80004-13:2024) 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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Any feedback and questions on this document should be directed to the users’ national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

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Endorsement notice

The text of ISO/TS 80004-13:2024 has been approved by CEN as CEN ISO/TS 80004-13:2024 without any modification.

Technical Specification

ISO/TS 80004-13

Nanotechnologies — Vocabulary —

Part 13: Graphene and other two-dimensional (2D) materials

Nanotechnologies — Vocabulaire —

Partie 13: Graphène et autres matériaux bidimensionnels (2D)

Second edition
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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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 document 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 or www.iec.ch/members_experts/refdocs).

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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. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared jointly by Technical Committee ISO/TC 229, *Nanotechnologies*, and Technical Committee IEC/TC 113, *Nanotechnology for electrotechnical products and systems,* and 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 80004-13:2017) which has been technically revised.

The main changes are as follows:

— addition of the term "graphene-related 2D material (GR2M)";

— expansion of defined terms to include "enhanced", "modified", "enabled" and "based", and derivatives thereof;

— indication that use of some terms are deprecated.

A list of all parts in the ISO 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

Over the last decade, huge interest has arisen in graphene, both scientifically and commercially, due to the many exceptional properties associated with this material, such as the electrical and thermal conductivity. More recently, other materials with a structure similar to that of graphene have also shown promising properties, including:

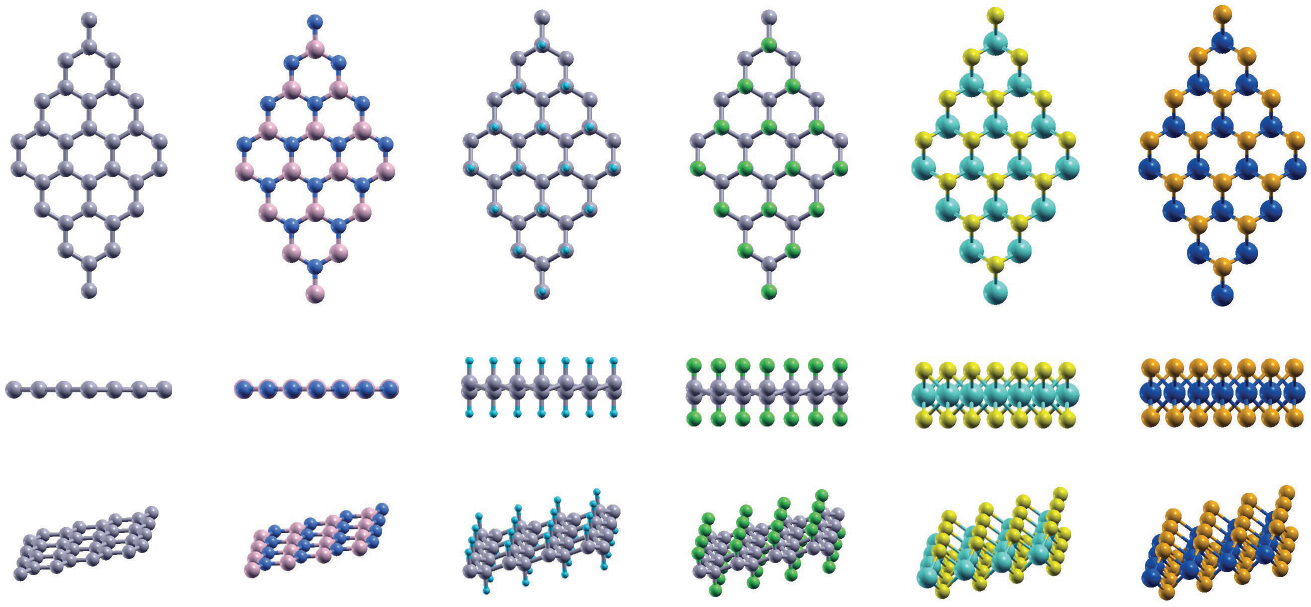
a) monolayer and few-layer versions of hexagonal boron nitride (hBN);

b) transition metal dichalcogenides such as molybdenum disulphide (MoS_2) and tungsten diselenide (WSe_2);

c) silicene and germanene;

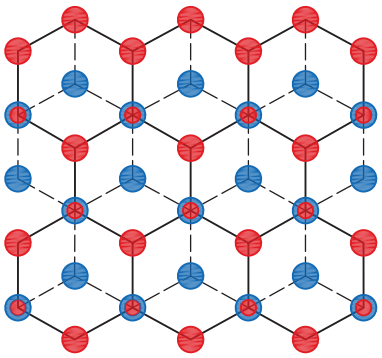
d) layered assemblies of mixtures of these materials.

These materials have their thickness constrained within the nanoscale or smaller and consist of between one and several layers. These materials are thus termed two-dimensional (2D) materials as they have one dimension at the nanoscale or smaller, with the other two dimensions generally at scales larger than the nanoscale. A layered material consists of 2D layers weakly stacked or bound to form three-dimensional structures. Examples of 2D materials and the different stacking configurations in graphene are shown in Figure 1. 2D materials are not necessarily topographically flat in reality and can have a buckled structure. They can also form aggregates and agglomerates which can have different morphologies. 2D materials are an important subset of nanomaterials.

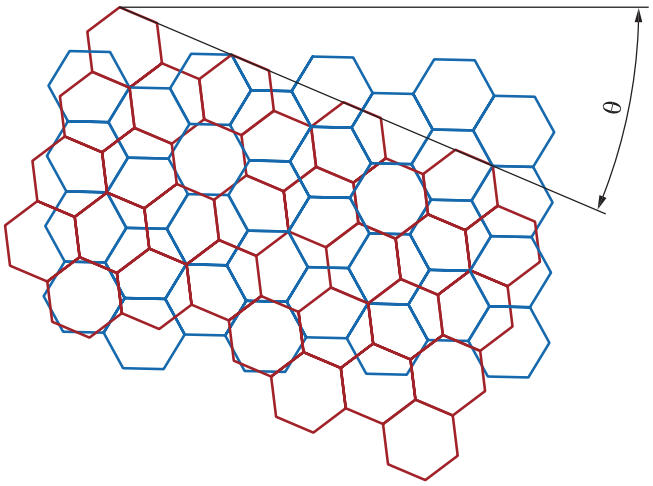


graphene | **hBN** | **graphane** | **perfluoro-graphane** | **MoS_2** | **WSe_2**

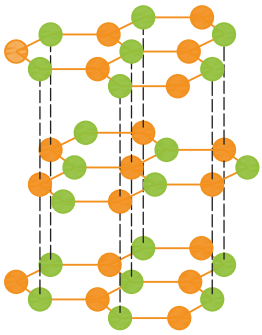
a) Examples of different 2D materials consisting of different elements and structures, as shown by the different coloured orbs and top-down and side views



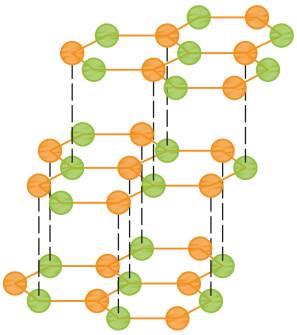
b) Bernal stacked bilayer graphene (3.1.2.7)



c) Turbostratic bilayer or twisted bilayer graphene with relative stacking angle (θ)(3.1.2.8)



ABA trilayer



ABC trilayer

d) Bernal stacked (AB) (3.4.1.12) tri-layer graphene (3.1.2.10) and rhombohedral (ABC) (3.4.1.13) stacked tri-layer graphene (3.1.2.10)

Figure 1 — Examples of 2D materials and the different stacking configurations in graphene layers

It is important to standardize the terminology for graphene, graphene-related and other 2D materials at the international level, as the number of publications, patents and organizations is increasing rapidly. Thus, these materials need an associated vocabulary as they become commercialized and sold throughout the world.

The document contains general terms related to 2D materials, those related to graphene, and those related to other 2D materials. It provides terms related to commonly used methods for producing and characterising 2D materials along, with terms related to 2D materials characteristics. It also includes performance related terms, such as “-enhanced” and “-enabled”, and those related to composition, such as “-based” and “-modified”, as shown in Figure 2.

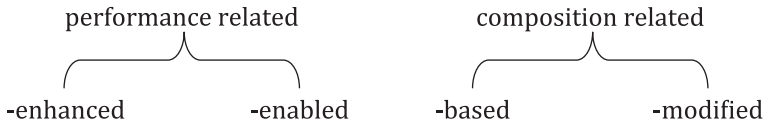


Figure 2 — General terms to describe 2D materials split into performance and composition related terms

This document belongs to a multi-part vocabulary, covering the different aspects of nanotechnologies. It builds upon ISO 80004-1, ISO/TS 80004-3 and ISO/TS 80004-6, and uses existing definitions where possible.

Technical Specification **ISO/TS 80004-13:2024(en)**

Nanotechnologies — Vocabulary —

Part 13:
Graphene and other two-dimensional (2D) materials

1 Scope

This document defines terms for graphene, graphene-related two-dimensional (2D) materials and other 2D materials. It includes related terms for production methods, properties and characterization.

It is intended to facilitate communication between organizations and individuals in research, industry and other interested parties and those who interact with them.

2 Normative references

There are no normative references in this document.