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Nanotehnologije - Okvir za razvrščanje 2D-materialov, povezanih z grafenom (ISO/TS 9651:2025)

Nanotechnologies - Classification framework for graphene□related 2D materials (ISO/TS 9651:2025)

Nanotechnologien - Klassifizierungsrahmen für Graphen-bezogene 2D-Materialien (ISO/TS 9651:2025)

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07.120	Nanotehnologije	Nanotechnologies

kSIST-TS FprCEN ISO/TS 9651:2027 **en,fr,de**

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Technical Specification

ISO/TS 9651

Nanotechnologies — Classification framework for graphene-related 2D materials

Nanotechnologies — Cadre de classification pour les matériaux bidimensionnels similaires au graphène

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Foreword

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Introduction

This document aims to provide commercial graphene producers and users with a standardized approach to classifying graphene-related 2D materials. It outlines a transparent methodology for categorizing these materials in any form, regardless of production methods or source materials. This approach facilitates accurate and straightforward comparisons between materials from different suppliers. Additionally, the document serves as a foundation for material specification data sheets, proposing a minimum set of relevant data that can be consistently used by producers, users, and regulators. Material characteristics deemed most critical for commercial applications—such as layer count, thickness, lateral flake size, disorder level, and specific surface area—can be identified using standard testing methods and documented in material data sheets.

The framework is primarily intended to support the creation and use of technical data sheets for specific forms of graphene-related 2D materials. It is not designed to prescribe production procedures or quality control testing processes, although some of the described test methods can serve as supporting techniques for those purposes.

Establishing a systematic classification framework for graphene-related 2D materials is essential for several key reasons. First, it ensures consistent and reliable regulation and registration processes, fostering transparency and trust in the market for both producers and users. Second, it enables a thorough understanding and quantification of material properties, forms, and contaminants. Finally, the adoption of universal standardized testing methods is critical for enabling easy, quantitative comparisons of data generated by different laboratories and users globally. This systematic approach will significantly advance the responsible development and use of graphene-related 2D materials.

It is also important to note that certain test methods are possibly not suitable for all forms of graphene-related 2D materials. When employing standardized testing methods, it is beneficial to provide multiple measurement techniques for evaluating different properties. However, these methods can yield varying results for the same sample due to differences in how each technique assesses specific aspects of the material.

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Nanotechnologies — Classification framework for graphene-related 2D materials

1 Scope

This document specifies the characteristics and their respective measurement methods of graphene-related 2D materials in sheet and particle forms for commercial applications with the aim of classification of the materials. The classification framework consists of the following elements:

a) relevant material characteristics for commercial use;

b) identification of applicable measurement methods;

c) a range of the characteristic measured values when applicable;

d) syntax to guide consistent naming and descriptions;

e) an applicable technical data sheet template.

2 Normative references

There are no normative references in this document.

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3 Terms and definitions

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For the purposes of this document, the following terms and definitions apply:

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

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

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

3.1
graphene-related 2D material
GR2M
DEPRECATED: graphene-based material, graphene-material
carbon-based two-dimensional material consisting of one to 10 layers, including graphene, graphene oxide, reduced graphene oxide, and functionalized variations thereof

Note 1 to entry: This includes bilayer graphene, trilayer graphene and few-layer graphene.

Note 2 to entry: The terms graphene-based material and graphene-material are deprecated here. They have been used to describe materials other than graphene, such as graphene oxide.

Note 3 to entry: "Graphene-related 2D material" is defined in contrast with graphene-based and GR2M-based.

[SOURCE: ISO/TS 80004-13, 3.1.1.2]

3.2
sheet
2D material typically situated upon a substrate, with extended lateral dimensions at the micro to macroscale

[SOURCE: ISO/TS 80004-13, 3.1.1.4]

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