
**Nanotechnologies — Guidance on
physico-chemical characterization of
engineered nanoscale materials for
toxicologic assessment**

Nanotechnologies — Directives relatives à la caractérisation physico-chimique des matériaux machinés à l'échelle nanométrique pour l'évaluation toxicologique



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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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

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Introduction

The last few years have seen a large increase in the use of nanomaterials in consumer and other products, and this increase has been accompanied by growing concern about the possible health and environmental impacts of exposure to nanomaterials, in particular to nano-objects, and their agglomerates, and aggregates (NOAA). While a large number of toxicological studies on materials in NOAA form have been reported, many have failed to provide detailed physico-chemical characterization of what has been tested, to evaluate the results obtained and to compare test results. Given the diversity of NOAAs that can be produced with seemingly similar composition, detailed physico-chemical characterization is critical for the precise identification of test materials and to support the development of understanding the toxicological impact of nanomaterials.

This Technical Report provides guidance for the physico-chemical characterization of manufactured nano-objects (those nano-objects that are intentionally produced for commercial purposes) prior to toxicological assessment, including both human and ecological-based assessments. The purpose of this Technical Report is to assist health scientists and experts from other disciplines to understand, plan, identify and address relevant physico-chemical characterization of such materials before conducting toxicological tests on them. Such activity should be seen as a prerequisite to any biological evaluation and is consistent with other ISO documents. For example, ISO 10993-18^[1] specifically addresses the chemical characterization of materials used in medical devices, and ISO 14971^[2] points out that a toxicological risk analysis takes into account the chemical nature of the materials.

Characterization is expected to provide valuable information about the influence of physico-chemical properties on the responses observed in toxicological testing. This Technical Report provides the following information which will be of value in the physico-chemical characterization of manufactured nano-objects submitted for toxicological assessment:

- how physico-chemical characterization fits within the framework of toxicological testing of NOAAs;
- physico-chemical characteristics deemed critical for assessment before toxicological testing; and
- what should be measured to assess the physico-chemical characteristics.

Nanotechnologies — Guidance on physico-chemical characterization of engineered nanoscale materials for toxicologic assessment

1 Scope

This Technical Report provides guidance for the physico-chemical characterization of manufactured nano-objects and their aggregates and agglomerates (NOAA) greater than 100 nm presented for toxicological testing in order to aid in assessing and interpreting the toxicological impact of manufactured nano-objects and to allow the material under test to be differentiated from seemingly similar materials. For each of the selected properties, a description, clarification, relevance, measurand and example measurement methods are provided.

This Technical Report will be of value to parties (e.g. toxicologists, ecotoxicologists, regulators, health and safety professionals) interested in assessing and interpreting the potential toxicological effect of manufactured NOAAs.

2 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 27687, ISO/TS 80004-1, ISO/TS 80004-3, ISO/IEC Guide 99 and the following apply.

2.1

aggregate

particle comprising strongly bonded or fused particles where the resulting external surface area may be significantly smaller than the sum of calculated surface areas of the individual components

NOTE 1 The forces holding an aggregate together are strong forces, for example covalent bonds, or those resulting from sintering or complex physical entanglement.

NOTE 2 Aggregates are also termed “secondary particles” and the original source particles are termed “primary particles”.

[ISO/TS 27687:2008, definition 3.3]

2.2

agglomerate

collection of weakly bound particles or aggregates or mixtures of the two where the resulting external surface area is similar to the sum of the surface areas of the individual components

NOTE 1 The forces holding an agglomerate together are weak forces, for example van der Waals forces, or simple physical entanglement.

NOTE 2 Agglomerates are also termed “secondary particles” and the original source particles are termed “primary particles”.

[ISO/TS 27687:2008, definition 3.2]

2.3

carbon nanotube

CNT

nanotube composed of carbon

NOTE Carbon nanotubes usually consist of curved graphene layers, including single-wall carbon nanotubes and multiwall carbon nanotubes.

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