ISO/DTR 23652

ISO/TC 229~~/WG 5~~

Secretariat: BSI

Date: 2024-02-06

Nanotechnologies — Considerations for radioisotope labelling methods of nanomaterials for performance evaluation

~~Approval stage~~

Nanotechnologies — Considérations relatives aux méthodes de marquage radio-isotopique des nanomatériaux pour l'évaluation des performances

ISO copyright office
Case postale 56 • CP 401 • Ch. de Blandonnet 8
CH-12111214 Vernier, Geneva 20
Tel. Phone: + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail: copyright@iso.org
Web www.iso.org
Website: www.iso.org

Published in Switzerland.

Contents

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 documentsdocument 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).

Attention is drawnISO draws attention to the possibility that some of the elementsimplementation of this document may beinvolve the subjectuse of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received.

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

For an explanation onof 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.htmlthe following URL:.

The committee responsible for thisThis document iswas prepared by Technical Committee ISO/TC 229, *Nanotechnologies*.

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

Prior to the clinical trials of nanomaterials intended for use in human medicine, their in vivo behavior can be behaviour has been evaluated throughin animal experiments. Several quantitative methods for assessing the biodistribution of nanomaterials have been developed. Among these methods, the biodistribution of radioisotope-labelled nanomaterials provides quantitative information on their distribution throughout the entire body.

The use of radioisotope-labelled nanomaterials for biodistribution studies is a well-established method for understanding the pharmacokinetics or toxicokinetics of nanomaterials in vivo. These methods assume that the distribution pattern of nanomaterials and radioisotope-labelled nanomaterials will be similar or nearly identical in vivo.

Radioisotope labelling of nanomaterials can be accomplished using a wide variety of radionuclides and associated labelling methods. However, for nanomaterials used for medicinal purposes, there are only a few matching pairs of nanomaterial and radioisotope labelling method that ensure the in vivo integrity of the radioisotope-labelled nanomaterial. Failure to identify and apply matching pairs of nanomaterial and radioisotope labelling method in studies preceding the clinical trial phase can lead to experimental data on biodistribution in which the nanomaterial and radio-label may have been separatedseparate during the experiment, resulting. This in turn can result in a large number of nanomaterials or nano-drugs failing in the clinical trial phase.

Nanotechnologies — Considerations for radioisotope labelling methods of nanomaterials for performance evaluation

1 Scope

~~In this technical report, we address the following: 1)~~ This document provides:

a) a review of radioisotope labelling methods that can be used for nanomaterials~~, 2) ;~~

b) the pros and cons of each radioisotope labelling method~~, and 3);~~

information on the selection of a matched pair of nanomaterial and radioisotope labelling method to ensure the in vivo integrity of radioisotope-labelled nanomaterials[1]~~.~~

Nanotechnologies — Considerations for radioisotope labelling methods of nanomaterials for performance evaluation

c) 1 or the stability of their performance.

1 Scope

This document reviews radioisotope labelling methods for nanomaterials and methods to ensure their in vivo integrity or stability of performance.

32 2Normative references

The following referenced documents are indispensable for the applicationreferred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

3 ISO 80004-1, *Nanotechnologies — Vocabulary — Part 1: Core vocabulary*

ISO/TS 80004-8, *Nanotechnologies — Vocabulary — Part 8: Nanomanufacturing processes*

43 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO /TS 80004-21, ISO/TS 80004-4, ISO/TS 80004-8, and the following 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
nanoscale
Lengthlength range approximately from 1 nm to 100 nm

Note 1 to entry: Properties that are not extrapolations from a larger size are predominantly exhibited in this length range.
ISO/TS 80004-1:2010, 2.1

[SOURCE: ISO 80004-1:2015, 2.1]

3.2
nanomaterial
Materialmaterial with any external dimension in the *nanoscale* (3.1) or having internal structure or surface structure in the nanoscale

,Note 1 to entry: This generic term is inclusive of nano-object and- nanostructured material.

[SOURCE: ISO/TS 80004-1:2010, definition2015, 2.4]

3.3
nanoparticle
nano-object with all three external dimensions in the *nanoscale* (3.1,),

Note 1 to entry: If the lengths of the longest to the shortest axes of the nano-object differ significantly (typically by more than three times), the terms nanofibre or nanoplate are intended to be used instead of the term nanoparticle. ISO/TS 27687:2008, definition 4.1

[SOURCE: ISO/TS 27687:2008, 4.1]

3.4
radioisotope
An unstable isotope of an element that decays or disintegrates spontaneously, emitting ionizing radiation that couldcan be alpha particles, beta particles and/or gamma rays. Note 1 to entry: Approximately 5,000 natural and artificial radioisotopes have been identified. ISO/DIS 19461-1

Note 1 to entry: Approximately 5 000 natural and artificial radioisotopes have been identified.

[SOURCE: ISO 19461-1:2018, 3.9, modified — "that can be alpha particles, beta particles and/or gamma rays" has been added to the definition.]

3.5
biodistribution
In this TR, the term 'biodistribution' refers to a technique used to monitor the movement and distribution of specific radiolabelled *nanomaterials* (3.2) within an experimental animal or human subject.

3.6
chelating agent
A substance having a molecular structure embodying several electron-donor groups which render it capable of combining with metallic ions by chelation. ISO/ 862:1984, definition 81.

[SOURCE: ISO 862:1984, 81]

3.7
specific activity
Totaltotal radioactivity of the sample divided by its mass {
Note 1 to entry: Specific activity is expressed in Bq/g}.

[SOURCE: ISO 3925:2014, definition 3.4., modified — In the term, "activity" has been changed to "radioactivity"; Note 1 to entry has been added.]

54 4Symbols and abbreviatedAbbreviated terms

BFC Bifunctional Chelating Agent

TATE 1,4,8,11- Tetraazacyclotetradecane-1,4,8,11-tetraacetic acid

CB-TE2A 4,11-Bis(carboxymethyl)-1,4,8,11-tetraazabicyclo[6.6.2]hexadecane

NOTA 1,4,7-Triazacyclononane-1,4,7-triacetic acid

DOTA 1,4,7,10-Tetraazacyclododecane- 1,4,7,10-tetraaceticacid

DFO Desferrioxamine

DLS Dynamic Light Scattering

PET Positron Emission Tomography