INTERNATIONAL STANDARD

ISO 18473-4

First edition
2022-02

Functional pigments and extenders for special applications —

Part 4: Nanoscale titanium dioxide for photocatalytic application

Reference number
ISO 18473-4:2022(E)

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

Published in Switzerland

Contents

Page

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).

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. 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 (see www.iso.org/patents).

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 by Technical Committee ISO/TC 256, *Pigments, dyestuffs and extenders*.

A list of all parts in the ISO 18473 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

Metal nanoparticles are promising materials as the heterogeneous catalyst in a variety of organic transformations. Their catalytic properties are functions of their size and crystal lattice parameters, and they show amazing levels of performance in terms of selectivity, activity and improved yield of products. In particular, nanoscale titanium dioxide (TiO_2) particles exhibited many special properties because the band gap of the nanoparticles increased with the decrease in size. The use of TiO_2 nanoparticles has received considerable attention in green synthetic organic chemistry, decomposition and removal of air and water contaminants, deodorization, and antibacterial, antifungal, self-cleaning and antifogging actions.

Functional pigments and extenders for special applications —

Part 4:
Nanoscale titanium dioxide for photocatalytic application

1 Scope

This document specifies requirements and corresponding test methods for nanoscale titanium dioxide (TiO_2) in either powder or suspension form for photocatalytic application.

This document is applicable to modified nanoscale titanium dioxide for photocatalytic application.

NOTE Such modification can be surface treatment, coating, doping and combination thereof.

2 Normative references

The following documents are referred 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.

ISO 591-1:2000, *Titanium dioxide pigments for paints — Part 1: Specifications and methods of test*

ISO 787-2, *General methods of test for pigments and extenders — Part 2: Determination of matter volatile at 105 °C*

ISO 787-9, *General methods of test for pigments and extenders — Part 9: Determination of pH value of an aqueous suspension*

ISO 787-11, *General methods of test for pigments and extenders — Part 11: Determination of tamped volume and apparent density after tamping*

ISO 787-18, *General methods of test for pigments and extenders — Part 18: Determination of residue on sieve — Mechanical flushing procedure*

ISO 3262-1, *Extenders — Specifications and methods of test — Part 1: Introduction and general test methods*

ISO 6227, *Chemical products for industrial use — General method for determination of chloride ions — Potentiometric method*

ISO 9277, *Determination of the specific surface area of solids by gas adsorption — BET method*

ISO 15528, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

ISO 18451-1, *Pigments, dyestuffs and extenders — Terminology — Part 1: General terms*

ISO 20814, *Nanotechnologies — Testing the photocatalytic activity of nanoparticles for NADH oxidation*

ISO 22197-1, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for air-purification performance of semiconducting photocatalytic materials — Part 1: Removal of nitric oxide*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18451-1 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
length range approximately from 1 nm to 100 nm

Note 1 to entry: Properties that are not extrapolations from larger sizes are predominately exhibited in this length range.

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

3.2
photocatalyst
substance that performs one or more functions based on oxidization and reduction reactions under photoirradiation, for example, self-cleaning

[SOURCE: ISO 17094:2014, 3.1, modified — deleted examples in the definition except for self-cleaning]

3.3
titanium dioxide photocatalyst
photocatalyst (3.2) consisting essentially of titanium dioxide (TiO_2) of the anatase and/or the rutile crystal structure

3.4
suspension
heterogeneous mixture of materials comprising a liquid and a finely dispersed solid material

[SOURCE: ISO/TS 80004-6:2021, 3.13]

3.5
median value of the size distribution
median value [d50] that separates a distribution into two equal parts

[SOURCE: ISO 17827-1:2016, 3.1, modified: Note 1 to entry deleted]

4 Classification and designation

4.1 Classification

4.1.1 The crystal structure of nanoscale titanium dioxide for photocatalytic application is classified into anatase phase, and mixture of mainly anatase with low content of rutile.

4.1.2 The form of the supplied material is classified as powder and suspension.

4.2 Designation

The material can be designated by, including but not limited to, the median value of the size distribution for primary particles.

5 Requirements and test methods

5.1 Appearance

The material, if supplied in the form of powder, shall be a white or yellowy-white powder.

NOTE It can appear with yellow colour when TiO_2 is doped with certain metallic ion.

5.2 Technical requirements

5.2.1 For nanoscale titanium dioxide photocatalyst conforming with this document, the essential requirements shall be as specified in Table 1. The conditional requirements are listed in Table 2 and Table 3. The conditional requirements shall be subject to the agreement between the interested parties.

Table 1 — Essential requirements for nano-TiO_2 photocatalyst

Characteristic	Unit	Requirement	Test method
Median primary particle size[a]	nm	≤ 100[b]	To be agreed between the interested parties: TEM[c] or other suitable method
Crystal structure	—	To be reported to buyer	XRD[d]
Specific surface area	m^2/g	≥ 35	ISO 9277
Residue on 45 µm sieve	% (mass fraction)	< 0,05	ISO 787-18
Bulk density	g/m^3	To be reported to buyer	ISO 787-11
Mass fraction of titanium dioxide	% (mass fraction)	≥ 80[e]	ISO 591-1:2000, Clause 7
pH value	—	1,5 to 9[f]	ISO 787-9

NOTE The presence of elements such as Hg, Pb or As can be reported to the buyer according to legislative requirements.

a See ISO 19749 and ISO 21363.

b The particle size distribution shall be reported by TEM D10, D50. D90 number based to buyer and one related TEM picture should also be attached.

c TEM — Transmission electron microscopy.

d XRD —X-ray diffraction.

e The sample is tested after subjection to ignition treatment. The low limit is set based on the current market survey, and the actual value depends on how much surface treatment and doping were done.

f The sample is tested based upon the 4 % (mass fraction) concentration, and the deviation of pH value between batches shall be less than 0,5.

5.2.2 The additional requirements listed in Table 2 for material in the form of powder shall be subject to agreement between the interested parties.

Table 2 — Additional requirements for nano-TiO_2 photocatalyst in the form of powder

Characteristic	Unit	Requirement	Test method
Moisture	% (mass fraction)	≤ 15	ISO 787-2
Loss on ignition	% (mass fraction)	≤ 20	ISO 3262-1

a ICP — Inductive Coupled Plasma Emission Spectrometer