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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for air-purification performance of semiconducting photocatalytic materials under indoor lighting environment —

Part 5: Removal of methyl mercaptan

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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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).

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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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 206, *Fine ceramics*.

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

Photocatalyst is a substance that performs decomposition and removal of contaminants, self-cleaning, antifogging, deodorization and antibacterial actions under photoirradiation. Its application has expanded considerably in recent years. The application of photocatalysts for indoor spaces has increasingly been sought as a solution to indoor environmental problems. Since conventional photocatalysts are responsive only to ultraviolet light, studies have been made to develop an indoor-light-active photocatalyst that makes effective use of indoor light, which room lights mainly emit, and thus demonstrates high photocatalytic performance indoors. The development has recently led to the commercialization of various indoor-light-active photocatalytic products, and there has been demand for the establishment of test methods to evaluate the performance of this type of photocatalyst.

This document, with ISO 22197-1 and ISO 22197-2 as the basis, is intended to provide a testing method to determine the performance of indoor-light-active photocatalytic materials with regards to the removal of methyl mercaptan, enabling swift distribution of photocatalytic products and thus contributing to a safe and clean environment.

Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for air-purification performance of semiconducting photocatalytic materials under indoor lighting environment —

Part 5: Removal of methyl mercaptan

1 Scope

This document specifies a test method for the determination of the air-purification performance, with regards to removal of methyl mercaptan, of materials that contain a photocatalyst or have photocatalytic films on the surface, usually made from semiconducting metal oxides such as titanium dioxide or other ceramic materials, by continuous exposure of a test piece to the model air pollutant under illumination with indoor light.

This document is intended for use with different kinds of materials, such as construction materials in flat sheet, board or plate shape, which are the basic forms of materials for various applications. This document also applies to materials in honeycomb form, and to plastic or paper materials containing ceramic microcrystals and composites. This document does not apply to powder or granular photocatalytic materials.

This test method is usually applicable to photocatalytic materials produced for air purification. This method is not suitable for the determination of other performance attributes of photocatalytic materials, i.e. decomposition of water contaminants, self-cleaning, antifogging and antibacterial actions.

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 6145-7, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 7: Thermal mass-flow controllers*

ISO 14605, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Light source for testing semiconducting photocatalytic materials used under indoor lighting environment*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO 17168-1, *Fine-ceramics (advanced ceramics, advanced technical ceramics) — Test method for air-purification performance of semiconducting photocatalytic materials under indoor lighting environment — Part 1: Removal of nitric oxide*

ISO 80000-1, *Quantities and units — Part 1: General*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17168-1 apply.

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

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

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

4 Symbols

f	air-flow rate of test gas converted into that at the standard state (0 °C, 101,3 kPa) (l/min)
ϕ_M	methyl mercaptan volume fraction at the reactor exit (µl/l)
ϕ_{M0}	supply volume fraction of methyl mercaptan (µl/l)
n_M	removal quantity, by test piece, of methyl mercaptan (µmol)
R_M	removal percentage, by test piece, of methyl mercaptan (%)

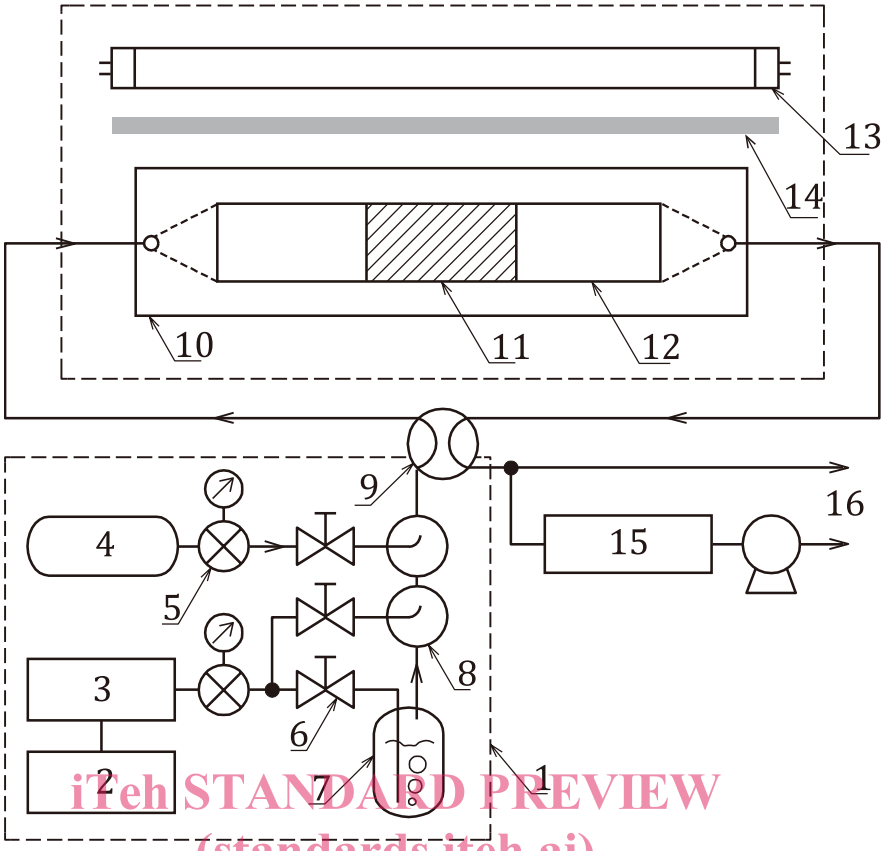
5 Principle

This document deals with the development, comparison, quality assurance, characterization, reliability and design data generation of photocatalytic materials[1]. The method described is intended to obtain the air-purification performance of photocatalytic materials by exposing a test piece to model polluted air under illumination by indoor light. Methyl mercaptan (methanethiol, CH_3SH) is chosen as a typical malodorous substance[2]. The test piece, placed in a flow-type photoreactor, is activated by indoor-light illumination, and adsorbs and oxidizes gas-phase methyl mercaptan. The air-purification performance is determined from the amount of the net removal of methyl mercaptan and removal rate of methyl mercaptan. The simple adsorption and desorption of CH_3SH by the test piece (not due to photocatalysis) is evaluated by tests in the dark. However, this document cannot be applied to test pieces which do not give a stable concentration of methyl mercaptan in the designated test time. The photocatalytic activity may depend on physical and chemical properties of pollutants, mainly due to the adsorption process involved. For a better evaluation of air purification performance of photocatalytic materials, it is recommended that one or more suitable test methods are combined, as provided in other parts of the ISO 17168 series.

6 Apparatus

6.1 Test equipment

The test equipment enables a photocatalytic material to be examined for its pollutant-removal capability by supplying the test gas continuously, while providing photoirradiation to activate the photocatalyst. It is the same as that used in the test method for the removal of nitric oxide (see ISO 17168-1) and consists of a test gas supply, a photoreactor, a light source, a UV sharp cut-off filter and pollutant measurement equipment. Since low concentrations of pollutants are to be tested, the system shall be constructed with materials of low adsorption and resistant to ultraviolet (UV) radiation, for example acrylic resin, stainless steel, glass and fluorocarbon polymers. An example of a test system is shown in Figure 1.



Key

1	test gas supply	9	four-way valve
2	air compressor	10	photoreactor
3	air-purification system	11	test piece
4	standard gas (pollutant)	12	airtight optical window
5	pressure regulator with a gauge	13	light source
6	mass-flow controller	14	sharp cut-off filter
7	humidifier	15	analyser
8	gas mixer	16	vent

Figure 1 — A schematic of the testing equipment

6.2 Test gas supply

The test gas supply provides air polluted with model contaminant at a predetermined concentration, temperature and humidity, and supplies it continuously to the photoreactor. It consists of flow regulators, a humidifier, gas mixers and so on. The flow rate of each gas should be within 5,0 % of the designated value, which is easily attained by using thermal mass-flow controllers with knowledge of temperature and gas type at calibration in accordance with ISO 6145-7. The expression of gas flow rate in this document is that converted to the standard state (0 °C, 101,3 kPa). Typical capacities of flow controller for pollutant gas, dry air and wet air are 50, 1 000 and 1 000 ml/min, respectively. The standard methyl mercaptan gas in a cylinder, normally balanced with nitrogen, shall have a volume fraction of 100 µl/l to 1 000 µl/l.

6.3 Photoreactor

The photoreactor holds a planar test piece within a 50-mm wide trough, with its surface parallel to an airtight optical window for photoirradiation. The reactor shall be fabricated from materials that adsorb