INTERNATIONAL STANDARD

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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for water purification performance of semiconducting photocatalytic materials by measurement of forming ability of active oxygen

Céramiques techniques — Méthode d'essai relative à la performance des matériaux photocatalytiques semi-conducteurs pour la purification de l'eau par mesurage de la capacité de formation de l'oxygène actif

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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.

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.

ISO 10676 was prepared by Technical Committee ISO/TC 206, *Fine ceramics*.

Introduction

Photocatalysis has many excellent functions including self-cleaning, antifogging, antibacterial actions, deodorization and removal of pollutants under light irradiation and, therefore, its application fields have been enlarged recently.

Among these applications, photocatalysis for water purification, which eliminates the pollutants in water, is being developed and its products are arriving on the market. Accordingly, there is strong demand for a test method which enables correct evaluation of the water purification performance.

This International Standard describes a test method for determining the water purification performance of photocatalytic materials used for water purification application.

Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for water purification performance of semiconducting photocatalytic materials by measurement of forming ability of active oxygen

1 Scope

This International Standard describes a test method covering photocatalytic materials formed on, or attached to, another material surface for the purpose of decomposing, and thus eliminating the pollutants in water, using photocatalytic performance.

This test method is applicable to photocatalytic materials under UV irradiation, and not under visible light irradiation.

2 Normative references

The following referenced documents are indispensable for the application 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 10677, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Ultraviolet light source for testing semiconducting photocatalytic materials*

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

3.1
photocatalyst
a substance that carries out one or more functions based on oxidization and reduction reactions under photoirradiation, including decomposition and removal of all air and water contaminants, deodorization, and antibacterial, self-cleaning and antifogging actions

3.2
water purification
purification by decomposing contaminants contained in water

3.3
photocatalytic materials
materials in which, or on which, the photocatalyst is added by coating, impregnation, mixing, etc.

NOTE Such photocatalytic materials are intended for use as building and road construction materials to obtain the above-mentioned functions.

3.4
purified water
water purified by the ion exchange method, having an electrical conductivity below 1 µS/cm

4 Principle

This International Standard covers the development, comparison, quality assurance, characterization, reliability and design data of photocatalytic materials. The method is used to determine the water purification performance of photocatalytic materials by exposing a specimen to model water under illumination of ultraviolet (UV) light.

It is difficult to choose a specific pollutant as the reagent for the purification performance test, because there are many types of pollutants in water.

Since the mechanism of water purification by photocatalytic reaction is based on the formation of active oxygen from the photocatalyst activated by UV irradiation, which oxidizes and decomposes the pollutants in water, it is possible to evaluate the water purification performance by measuring the ability of active oxygen to form from the activated photocatalyst in water.

Therefore, dimethylsulfoxide (DMSO) is chosen as an indicator that gives methanesulfonic acid (MSA) as a product of the photocatalytic reaction, as shown in the following formula [methanesulfinate (MSI) is produced as an intermediate]. This reaction is often used for the determination of active oxygen. The specimen, set in a flow-type photoreactor, is activated by UV irradiation; the DMSO is decomposed, which results in the production of MSA on its surface. The water purification performance is determined based on the decrease in concentration of DMSO and the generation of MSA. The adsorption of DMSO by the specimen is evaluated by the test in the dark (without UV irradiation).

a) $(CH_3)_2SO$ (DMSO) + · OH → $CH_3S(O)OH$ (MSI) + · CH_3

b) $CH_3S(O)OH$ (MSI) + · OH + O_2 → $CH_3S(O)_2OH$ (MSA) + · OOH

c) $(CH_3)_2SO$ (DMSO) + · OOH → $CH_3S(O)_2OH$ (MSA) + · CH_3

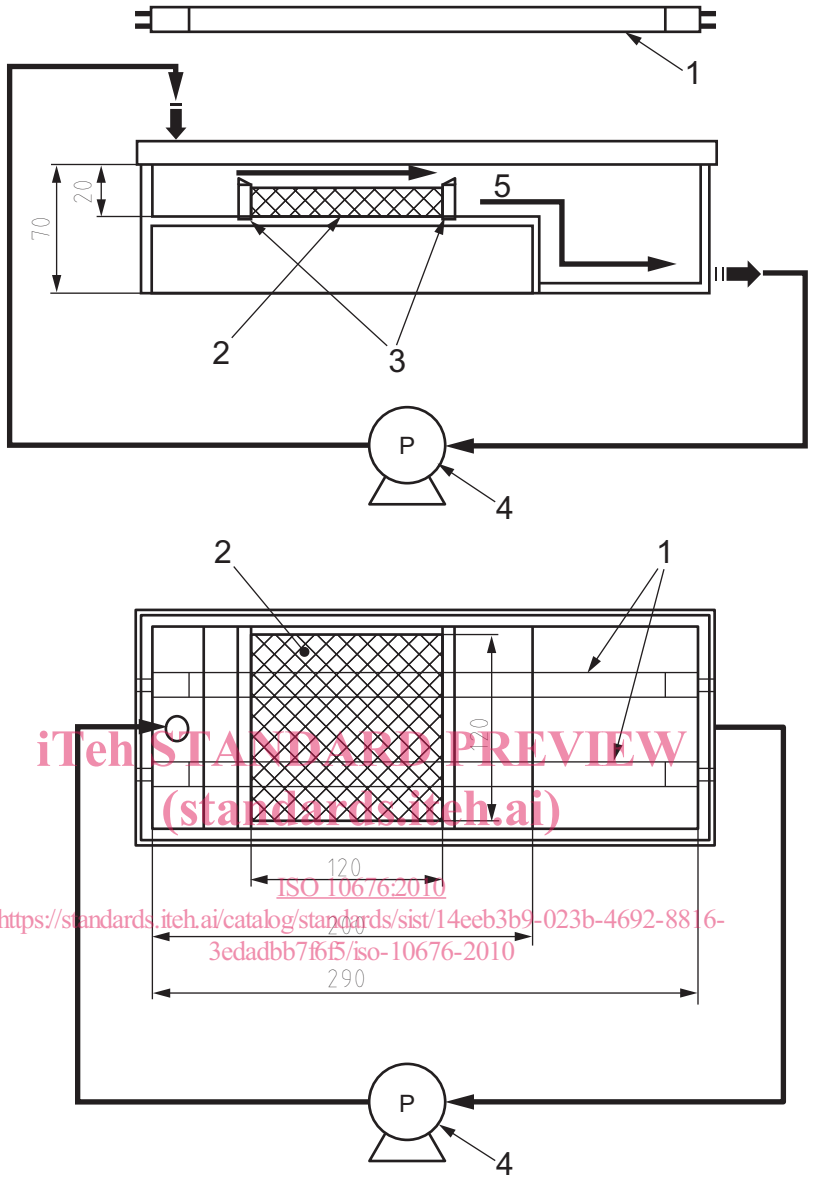
d) $CH_3S(O)_2OH$ (MSA) + · OH → H_2SO_4 + · CH_3

5 Apparatus

The testing equipment examines a photocatalytic material for its water purification performance by supplying and circulating the test water continuously, while providing photoirradiation to activate the photocatalyst. It consists of a test water supply, a photoreactor (with weirs), a light source and measurement equipment for testing the water. There is no cover in the photoreactor, i.e. the test is carried out in an open system.

An example of a testing system is shown in Figure 1.

Dimensions in millimetres



Key

1 lamp
2 test piece
3 weirs
4 pump
5 test solution

Figure 1 — Schematic diagrams of testing equipment

The testing equipment consists of the components described in 5.1 to 5.5

5.1 Test-water supply

The test-water supply consists of a flow controller (see Note) and a water pipe for circulating the test water with the predetermined speed and volume in the photoreactor.