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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for antibacterial activity of semiconducting photocatalytic materials under indoor lighting environment

Céramiques techniques — Méthode d'essai de l'activité antibactérienne des matériaux photocatalytiques semiconducteurs dans un environnement d'éclairage intérieur

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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.

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 206, *Fine ceramics*.

Introduction

A test method for cloths or textiles is not included in this International Standard because of a lack of indoor-light-active photocatalytic cloths or textiles. When indoor-light-active photocatalytic cloths or textiles have been developed, a suitable test method will be proposed with the remediated glass adhesion method given in ISO 27447.

Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for antibacterial activity of semiconducting photocatalytic materials under indoor lighting environment

WARNING — Handling and manipulation of microorganisms that are potentially hazardous requires a high degree of technical competence. Only personnel trained in microbiological techniques should carry out tests.

1 Scope

This International Standard presents a test method for determining the antibacterial activity of materials that contain an indoor-light-active photocatalytic material or have indoor-light-active photocatalytic films on the surface by measuring the survival of bacteria after illumination with indoor light.

It is intended for use with different kinds of indoor-light-active photocatalytic materials used in construction materials in flat sheet, board or plate shape that are the basic forms of materials for various applications. It does not include powder, granular, or porous indoor-light-active photocatalytic materials, nor is it applicable to cloths or textiles.

It is applicable to indoor-light-active photocatalytic materials produced for antibacterial application. Other types of performance of indoor-light-active photocatalytic materials, i.e. decomposition of water contaminants, self-cleaning, antifogging, and air purification, cannot be determined by this method.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 27447, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for antibacterial activity of semiconducting photocatalytic materials*

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

3 Terms and definitions

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

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

3.2
indoor-light-active photocatalyst
photocatalyst that functions under illumination with artificial light used for general lighting purposes

3.3
indoor lighting environment
illumination with artificial light source(s) used for general lighting purposes and excluding sunlight

3.4
indoor-light-active photocatalytic material
material in which or on which the indoor-light-active photocatalyst is added by coating, impregnation, mixing, etc

3.5
antibacterial
condition inhibiting the growth of bacteria on the surface of flat surface materials

3.6
indoor-light-active photocatalyst antibacterial activity value
numerical difference between the logarithmic values of the total number of viable bacteria on the indoor-light-active photocatalytic treated material and non-treated material after indoor light illumination

Note 1 to entry: This value includes the decrease of number of bacteria without indoor light illumination.

3.7
indoor-light-active photocatalyst antibacterial activity value with indoor light illumination
numerical difference between the logarithmic values of the total number of viable bacteria on the indoor-light-active photocatalytic treated material after indoor light illumination and the same material kept in the dark

4 Symbols

A	average number of viable bacteria on non-treated test pieces, just after inoculation
B_D	average number of viable bacteria on non-treated test pieces, after being kept in a dark place
B_L	average number of viable bacteria on non-treated test pieces, after indoor light illumination of intensity L
C_D	average number of viable bacteria on indoor-light-active photocatalytic treated test pieces, after being kept in dark place
C_L	average number of viable bacteria on indoor-light-active photocatalytic treated test pieces, after indoor light illumination of intensity L
D_F	dilution factor
L	illuminance of indoor light
L_{max}	maximum logarithmic value of viable bacteria
L_{mean}	average logarithmic value of viable bacteria for three test pieces
L_{min}	minimum logarithmic value of viable bacteria
N	number of viable bacteria
P	bacteria concentration
R_L	indoor-light-active photocatalyst antibacterial activity value, after illumination at a constant intensity (L) on an indoor-light-active photocatalytic material
ΔR	indoor-light-active photocatalyst antibacterial activity value with indoor light illumination

V volume of soybean-casein digest broth with lecithin and polysorbate 80 medium for washout

Z average number of colonies in two Petri dishes

5 Principle

The method is used to obtain the antibacterial activity of indoor-light-active photocatalytic materials by contact of a test piece with bacteria, under indoor lighting condition. The film cover method is available for flat sheet, board, or plate-shaped materials.

The test piece is laid in a Petri dish and the bacterial suspension is dripped onto the test piece. Then the cover film is placed on the suspension and the moisture conservation glass is placed on top of the Petri dish. The Petri dish containing the test piece is exposed to light. After exposure, the test bacteria are washed out of the test piece and the cover film. This washout suspension is measured by the viable bacterial count method.

6 Materials

6.1 Bacteria strains and preparation for tests

6.1.1 Bacteria strains

The bacteria strains to be used in the test shall be the same as or equivalent to those described in Table 1 and supplied by an entity that is registered under the World Federation for Culture Collections or the Japan Society for Culture Collections.

Table 1 — Bacteria strains to be used in test

Bacteria species	WDCM code
Staphylococcus aureus	WDCM 00195
Escherichia coli	WDCM 00196
NOTE Refer to WDCM (World Data Centre for Microorganisms) and its website: http://www.wdcm.org/.	

NOTE If necessary, additional tests with other bacteria can be allowed.

6.1.2 Bacteria preparation

Aseptic manipulations using microorganisms should be performed in an adequate safety cabinet. Inoculate each strain into slant culture medium (nutrient agar medium), incubate for 16 h to 24 h at 37 °C ± 1 °C, and then store in a refrigerator at 5 °C to 10 °C. Repeat subcultures within one month by replicating this process. The maximum number of subcultures from the original strain transferred by culture collection is 10. A slant culture shall not be stored for more than one month.

NOTE 1 In the case of bacteria stored in deep freezer, the maximum number of subcultures from original strain transferred by culture collection is 10.

NOTE 2 If activity of used bacteria is maintained, agar plates can be used.

6.2 Chemicals and implements

6.2.1 General

Commercial media of same components described below can be used.