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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for complete decomposition performance of semiconducting photocatalytic materials under indoor lighting environment — Decomposition of acetaldehyde

Céramiques fines (céramiques avancées, céramiques techniques avancées) — Méthode d'essai pour déterminer la performance de décomposition complète des matériaux photocatalytiques semi-conducteurs dans un environnement d'éclairage intérieur — Décomposition de l'acétaldéhyde

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Foreword

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

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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for complete decomposition performance of semiconducting photocatalytic materials under indoor lighting environment — Decomposition of acetaldehyde

1 Scope

This document specifies a test method for the determination of complete decomposition performance of indoor light-active photocatalytic materials under an indoor lighting environment using acetaldehyde. In this document, photocatalytic materials are usually made from semiconducting metal oxides, such as titanium dioxide, tungsten trioxide or other ceramic materials, and they are treated in powder form. This document does not apply to film, flat sheet, board and other plate-shape materials.

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 4224, *Ambient air — Determination of carbon monoxide — Non-dispersive infrared spectrometric method*

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.

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/

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

3.2
indoor lighting environment
environment with artificial light source for general lighting service

Note 1 to entry: Does not include sunlight.

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3.3
indoor light-active photocatalytic materials
materials which perform one or more functions based on oxidation and reduction reactions under indoor lighting environment

3.4
zero-calibration gas
air which does not contain pollutants (i.e. common pollutants are below 0,01 µl/l) or carbon dioxide (i.e. carbon dioxide is below 1,0 µl/l.)

Note 1 to entry: The zero-calibration gas is supplied as synthetic air in a gas cylinder.

3.5
standard gas
diluted gases of known concentrations supplied in cylinders and certified by an accredited laboratory

3.6
test gas
mixture of air and pollutant(s) of known concentration prepared from a standard gas or a zero-calibration gas, to be used for the performance test of a photocatalytic material

3.7
dark conditions
test conditions of no light illumination by the light source for testing and room lighting

3.8
complete decomposition
complete mineralization through oxidative decomposition of organic compounds by a photocatalyst, producing carbon dioxide and water

4 Principle

This document has been established to develop, compare and evaluate the characteristics and capabilities of practical indoor light-active photocatalysts.

This document serves as an evaluative index for complete decomposition performance for indoor light-active photocatalytic materials under indoor light irradiation, selects acetaldehyde as the target gas for evaluation and establishes an objective and reproducible test method.

This test entails the use of a photoreactor with a sealable structure provided with a light-transmitting window and a gas inlet/collection port. A photocatalyst serving as a test sample is placed inside the photoreactor, which is then sealed. First, as a pretreatment, the test sample is photoirradiated until production of carbon dioxide ceases. After confirming that production of carbon dioxide has ceased, air in the photoreactor is displaced by a zero-calibration gas. Acetaldehyde gas is then injected into the reactor in a dark location until the concentration of acetaldehyde gas in the reactor reaches 100 ppm. The reactor is left in the dark for 1 h and then irradiated with indoor light. At regular intervals, the gas in the reactor is analysed, and the concentrations of acetaldehyde and carbon dioxide are measured. It is considered complete decomposition when the concentration of carbon dioxide reaches a twofold equivalent of the acetaldehyde injected, and the increase of carbon dioxide ceases simultaneously.

5 Apparatus

5.1 Test equipment

The test equipment is used to evaluate complete decomposition performance of acetaldehyde by a test sample of a photocatalytic powder when test gas is introduced to a photoreactor in which the test sample has been placed and sealed, then irradiated with indoor light. The test equipment consists of the

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