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Fine ceramics (advanced ceramics, advanced technical ceramics) — Thermophysical properties of ceramic composites — Determination of unidimensional thermal diffusivity by flash method

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Contents

Page

Foreword ... **iv**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **1**

4 Principle ... **2**

5 Apparatus ... **2**
5.1 Heat pulse source ... 2
5.2 Test chamber ... 2
5.3 Detectors ... 2
5.3.1 Measurement of absolute temperature ... 2
5.3.2 Transient detectors ... 3
5.4 Data acquisition ... 3

6 Test specimens ... **4**

7 Test specimen preparation ... **4**
7.1 Machining and preparation ... 4
7.2 Number of test specimens ... 4

8 Procedure ... **4**
8.1 Calibration of apparatus ... 4
8.2 Procedure ... 4

9 Results ... **5**
9.1 Determination of the thermal diffusivity ... 5
9.2 Sources of uncertainties ... 5

10 Test report ... **5**

Annex A (informative) **Unidimensional thermal model** ... **9**

Annex B (informative) **Experimental characteristics for optimal measurements** ... **11**

Bibliography ... **12**

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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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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.

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Fine ceramics (advanced ceramics, advanced technical ceramics) — Thermophysical properties of ceramic composites — Determination of unidimensional thermal diffusivity by flash method

1 Scope

This document describes the flash method for the determination of thermal diffusivity of ceramic matrix composites with continuous fibre reinforcement.

In order to conform with the unidimensional heat transfer hypothesis, the experimental conditions are defined such that the material behaves in a homogeneous manner. This involves performing tests in one symmetry axis of the composite.

The method is applicable to materials which are physically and chemically stable during the measurement, and covers the range of temperature from 100 K to 2 800 K. It is suitable for the measurement of thermal diffusivity values in the range 10^{-4} $m^2 \cdot s^{-1}$ to 10^{-7} $m^2 \cdot s^{-1}$.

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 3611, *Geometrical product specifications (GPS) — Dimensional measuring equipment: Micrometers for external measurements — Design and metrological characteristics*

ISO 20507, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Vocabulary*

EN 60584-1, *Thermocouples — Part 1: Reference tables (IEC 60584-1:1995)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20507 and the following 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
thermal diffusivity
a
ratio of the thermal conductivity to the product of the bulk density and the specific heat capacity

3.2
transient half time
$t_{1/2}$
time from the initiation of the pulse until the increase of the temperature on the back face of the test specimen reaches one half of the maximum temperature increase

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3.3
thickness
h
dimension of the test specimen in the direction of heat transfer measurement

4 Principle

One side of a plane- and parallel-face test piece is exposed to a uniformly distributed energy pulse that is of very short duration compared with the transient half time.

The transient temperature rise (ΔT) on the opposite face (back face) or a quantity directly proportional to ΔT is recorded as a function of time (t) (see Figure 1).

The thermal diffusivity is obtained by comparing the experimental thermogram with a theoretical model, which is a unidimensional analytical thermal model, with two parameters, as described in Annex A. If other models are used, they are to be specified in the test report.

5 Apparatus

5.1 Heat pulse source

The heat pulse source may be a flash tube or a pulse laser.

The pulse energy shall be as uniform as possible over the front face of the test piece.

5.2 Test chamber

The test chamber shall be either a furnace or a cryostat, capable of operation within the temperature range required, or a draught proof enclosure for ambient temperature measurement.

The design of the furnace shall meet the following requirements:

a) it shall contain a working area in which the spatial temperature gradient is sufficiently low (≤5 K over working area width) to result in a homogeneous temperature on the test piece;

b) in steady state conditions, the drift in temperature shall be less than 0,01 K/s;

c) the heat pulse source may be placed either inside the furnace or outside the furnace; in the latter case, the furnace shall be fitted with a window, transparent to the pulse radiation;

d) the furnace shall provide suitable access for measurement of ΔT or a quantity directly proportional to ΔT on the back face of the test piece.

When the test is performed under gas, the test piece should be in a horizontal position in order to reduce convection effects of the gas on the specimen.

NOTE Measurement under vacuum will reduce convection losses and will limit the oxidation phenomena at high temperature.

5.3 Detectors

5.3.1 Measurement of absolute temperature

The temperature of the test piece shall be measured either with a thermocouple (in accordance with EN 60584-1) or with an optical pyrometer.

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