International Standard

ISO 19618

Fine ceramics (advanced ceramics, advanced technical ceramics) — Measurement method for normal spectral emissivity using blackbody reference with an FTIR spectrometer

Céramiques techniques — Méthode de mesure de l'émissivité spectrale normale au moyen d'un corps noir de référence par spectrométrie infrarouge à transformée de Fourier (IRTF)

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Foreword

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

This second edition cancels and replaces the first edition (ISO 19618:2017), which has been technically revised.

The main changes are as follows:

— correction of the procedure for the linearity verification of the FTIR system in 7.3;

— addition of the thermal history of the specimen to the items to be reported in Clauses 6 and 11;

— correction of the terms to be used for the calculations in Clause 10.

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Fine ceramics (advanced ceramics, advanced technical ceramics) — Measurement method for normal spectral emissivity using blackbody reference with an FTIR spectrometer

1 Scope

This document specifies a method used for the determination of normal spectral emissivity and normal quasi-total emissivity of fine ceramics using blackbody reference with a Fourier transform infrared spectrometer (FTIR) at elevated temperatures. This method is applicable to fine ceramics, ceramic matrix composites, and continuous fibre-reinforced ceramic matrix composites which are opaque and highly non-reflective at wavelengths between 1,67 µm and 25 µm. The applicable temperature range is approximately 350 K to 1 100 K.

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.

IEC 60584-2, *Thermocouples — Part 2: Tolerances*

IEC 60751, *Industrial platinum resistance thermometers and platinum temperature sensors*

3 Terms and definitions

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

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

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

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

3.1
emissivity
ε
ratio of the radiant emittance of a substance (specimen) to the radiant emittance of a *blackbody* (3.2) at the same temperature

3.2
blackbody
ideal thermal radiator that absorbs all incident radiation completely, whatever the wavelength, direction of incidence or polarization

3.3
spectral emissivity
$\varepsilon_{s,\lambda,T}$
emissivity (3.1) of a specimen at a defined wavelength λ and temperature T

3.4
normal spectral emissivity
$\varepsilon_{\mathrm{ns},\lambda,T}$
emissivity (3.1) perpendicular to the specimen at a defined wavelength λ and temperature T

3.5
normal total emissivity
$\varepsilon_{\mathrm{n},T}$
ratio of the normal component of the total emissive power of a specimen surface to the normal component of the total emissive power of a *blackbody* (3.2) at the same temperature T

3.6
normal quasi-total emissivity
$\varepsilon_{\mathrm{n},\lambda_1,\lambda_2,T}$
normal emissivity between λ_1 and λ_2 at temperature T

Note 1 to entry: Calculated as the ratio of the normal component of the emissive intensity of a specimen between λ_1 and λ_2 to the normal component of the emissive intensity of a blackbody between λ_1 and λ_2 at the same temperature T.

4 Principle

The infrared radiance spectrum data from a specimen surface and from a blackbody furnace are measured using an FTIR spectrometer. The normal spectrum emissivity of a specimen is determined by direct comparison to a blackbody reference data at the same temperature.

The normal quasi-total emissivity is calculated by integrating the infrared radiance spectrum data in the specified wavelength range numerically.

5 Apparatus

5.1 Measurement system

The measurement system consists of a Fourier transform infrared spectrometer (FTIR), specimen heating device, blackbody furnace, and temperature measuring devices as shown in Figure 1. Other optical arrangements than the one presented in Figure 1 can also be used, such as the blackbody and then the specimen heating device travelling linearly in front of the FTIR spectrometer.

5.2 Fourier transform infrared spectrometer (FTIR)

Infrared radiation from a specimen or a blackbody furnace is let into a Michelson interferometer of an FTIR through an external optical path. Thereby, an interferogram of infrared radiation is obtained. The infrared radiance spectrum is obtained numerically by Fourier transformation processing from the interferogram.

The optical system including a Michelson interferometer of an FTIR shall be filled with dry N_2 or dry air, the dew point of the latter being lower than 220 K to reduce the effect of H_2O and CO_2 in air. Vacuum may be used.

The measurement spot area at the sample position and at the blackbody furnace positions shall be measured preliminarily. It shall have a very sharp optical definition to avoid stray radiations.

5.3 Specimen heating device

A specimen shall be heated using a heating device such as electrical resistance heating elements, heat-pipes, heat-transfer media, etc. The specimen surface temperature shall be well controlled to within ±3 K.

An example of a specimen heating device is depicted in Figures 2 and 3.