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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for interfacial tensile and shear fatigue properties of ceramic joining loaded in constant amplitude at room temperature

Céramiques fines (céramiques avancées, céramiques techniques avancées) — Méthode d'essai relatives aux propriétés de tension interfaciale et de fatigue en cisaillement des jonctions céramiques à amplitude constante

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Foreword

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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*.

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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for interfacial tensile and shear fatigue properties of ceramic joining loaded in constant amplitude at room temperature

1 Scope

This document specifies a test method for determining interfacial tensile/tensile or shear/shear cyclic fatigue properties of ceramic-ceramic, ceramic-metal, and ceramic-glass joining loaded in the constant amplitude at room temperature. Procedures for test piece preparation, test modes and rates (load rate or displacement), data collection and reporting procedures are given.

This document applies primarily to ceramic materials, including monolithic fine ceramics and whisker-, fibre- or particle-reinforced ceramic composites. This test method can be used for material research, quality control, and characterization and design data-generation purposes.

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 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

ISO 13124, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for interfacial bond strength of ceramic materials*

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 http://www.iso.org/obp

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

3.1
cross-bonded test piece
test sample in the form of a symmetrical cross

Note 1 to entry: Prepared by joining two rectangular bars with the same shape and size, as described in ISO 13124.

3.2
average applied stress during cyclic fatigue
σ_m
average value between the maximum applied stress and the minimum applied stress during cyclic fatigue

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3.3
constant amplitude loading
under a given average applied stress, σ_m, keeping peak loads and valley loads constant for wave form loading in cyclic fatigue loading, $\Delta\sigma = (\sigma_{max} - \sigma_{min})/2 = \sigma_{max} - \sigma_m = \sigma_m - \sigma_{min}$

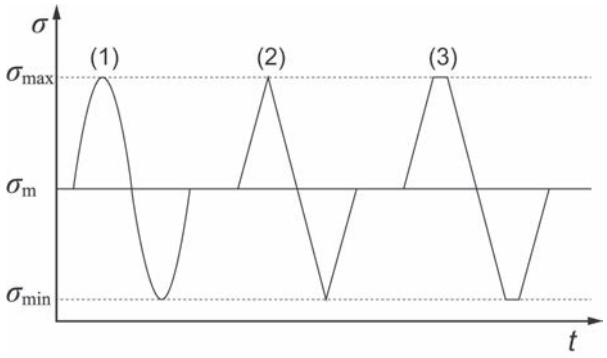
3.4
number of cycles
N
total number of loading cycles applied to the test piece during the test

3.5
cyclic fatigue life
N_f
total number of loading cycles until the test piece is up to failure

3.6
time to failure
t_f
time duration until the test piece is up to failure

4 Principle

A cross-bonded test piece is cycled under a given average stress with constant amplitude loading at room temperature, which yields cyclic tensile/tensile or shear/shear stress in the interface. Typical cyclic loading waves including sine wave, triangular wave and trapezoidal wave are shown in Figure 1. Two different forms of mounting the cross-bonded test piece in a fixture are designed to measure the interfacial tensile/tensile and shear/shear fatigue properties by using compressive/compressive fatigue loads, respectively. The total number of cycles is recorded. The lifetime duration including cyclic fatigue time and time to failure or the residual interfacial bonding strength is determined.



Key

1	sine wave
2	triangular wave
3	trapezoidal wave
σ	applied stress
σ_{max}	maximum applied stress during cyclic fatigue
σ_{min}	minimum applied stress during cyclic fatigue
σ_m	average applied stress during cyclic fatigue, $\sigma_m = (\sigma_{max} + \sigma_{min})/2$
t	testing time

Figure 1 — Schematic illustration of three typical cyclic loading waves

NOTE 1 The typical fatigue test is defined by cyclic loading, average stress, constant amplitude, environment and frequency. The loading condition has the form $\sigma = \sigma_m \pm \Delta\sigma$ under a given frequency.

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