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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for elastic moduli of monolithic ceramics at room temperature by sonic resonance

Céramiques techniques — Méthode d'essai des modules d'élasticité des céramiques monolithiques, à température ambiante, par résonance acoustique

Reference number
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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.

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

This second edition cancels and replaces the first edition (ISO 17561:2002), which has been technically revised. It also incorporates the Technical Corrigendum ISO 17561:2002/Cor.1:2007.

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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for elastic moduli of monolithic ceramics at room temperature by sonic resonance

1 Scope

This International Standard describes the method of test for determining the dynamic elastic moduli of fine ceramics at room temperature by sonic resonance. This International Standard is for fine ceramics that are elastic, homogeneous and isotropic.[2]

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

ISO 13385 (all parts), *Geometrical product specifications (GPS) — Dimensional measuring equipment*

3 Terms and definitions

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

3.1
dynamic elastic moduli
adiabatic elastic moduli, which are dynamic Young's modulus, shear modulus and Poisson's ratio

Note 1 to entry: Adiabatic elastic moduli are obtained by the sonic resonance method.

3.1.1
Young's modulus
E
elastic modulus in tension or compression

$$E = \sigma / \varepsilon$$

where

E is Young's modulus in pascals;

σ is the tension or compression stress in pascals;

ε is the tension or compression strain.

3.1.2
shear modulus
G
elastic modulus in shear or torsion

$$G = \tau / \gamma$$

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where

G is the shear modulus in pascals;

τ is the shear or torsional stress in pascals;

γ is the shear or torsional strain.

3.1.3
Poisson's ratio
ν
ratio of transverse strain to the corresponding axial strain resulting from uniformly distributed axial stress below the proportional limit of the material

Note 1 to entry: In isotropic materials, Young's modulus (E), shear modulus (G) and Poisson's ratio (ν) are related by the following formula:

$$\nu = E/(2G) - 1$$

3.2 vibration

3.2.1
flexural vibration
vibration apparent when the oscillation in a slender bar is in plane normal to the length dimension

Note 1 to entry: Also defined as vibration in a flexural mode.

3.2.2
torsional vibration
vibration apparent when the oscillation in each cross-section plane of a slender bar is such that the plane twists around the length dimension axis

Note 1 to entry: Also defined as vibration in a torsional mode.

3.3
resonance
state if, when a slender bar driven into one of the above modes of vibration, the imposed frequency is such that the resultant displacements for a given amount of driving force are at a maximum

Note 1 to entry: The resonant frequencies are natural vibration frequencies which are determined by the elastic modulus, mass and dimensions of the test piece.

3.4
fundamental frequency
lowest frequency of a periodic waveform

3.5
nodes
location(s) in slender rod or bar in *resonance* (3.3) having a constant zero displacement

Note 1 to entry: For the fundamental flexural resonance, the nodes are located at 0,224 L from each end, where L is the length of the rod or bar.

4 Summary of test method

This test method measures the flexural or torsional frequencies of test specimens of rectangular prism or cylindrical geometry by exciting them at continuously variable frequencies. Mechanical excitation of the specimens is provided through the use of a transducer that transforms a cyclic electrical signal into a cyclic mechanical force on the test piece. A second transducer senses the resulting mechanical vibrations of the test piece and transforms them into an electrical signal. The amplitude and the

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