ILNAS

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ILNAS-EN 15042-2:2006

Thickness measurement of coatings and characterization of surfaces with surface waves - Part 2: Guide to the thickness measurement of coatings by

Schichtdickenmessung und Charakterisierung von Oberflächen mittels Oberflächenwellen - Teil 2: Leitfaden zur photothermischen

Mesure de l'épaisseur des revêtements et caractérisation des surfaces à l'aide d'ondes de surface - Partie 2 : Guide pour le mesurage photothermique de

04/2006

National Foreword

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EUROPEAN STANDARD EN 15042-2

NORME EUROPÉENNE

EUROPÄISCHE NORM

April 2006

ICS 17.040.20

English Version

Thickness measurement of coatings and characterization of surfaces with surface waves - Part 2: Guide to the thickness measurement of coatings by photothermic method

Mesure de l'épaisseur des revêtements et caractérisation des surfaces à l'aide d'ondes de surface - Partie 2 : Guide pour le mesurage photothermique de l'épaisseur des revêtements

Schichtdickenmessung und Charakterisierung von Oberflächen mittels Oberflächenwellen - Teil 2: Leitfaden zur photothermischen Schichtdickenmessung

This European Standard was approved by CEN on 2 March 2006.

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Ref. No. EN 15042-2:2006: E

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Foreword

This document (EN 15042-2:2006) has been prepared by Technical Committee CEN/TC 262 “Metallic and other inorganic coatings”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2006, and conflicting national standards shall be withdrawn at the latest by October 2006.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This document describes methods for the measurement of the thickness of coatings by means of thermal waves generated by a radiation source.

The method can be used for coatings whose thermal properties (e.g. thermal conductivity) are different from those of the substrates in a range from a few microns to some hundred microns.

2 Normative references

The following referenced documents are indispensable for the application 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/DGuide 99998, *Guide to the expression of uncertainty in measurement (GUM) – Supplement 1: Numerical methods for the propagation of distributions*

3 Terms and definitions

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

3.1
amplitude of the thermal wave
ΔT_0
maximum local temperature variation of the oscillating part for periodic-harmonic heating processes

NOTE See Equation 2.

3.2
penetration depth of thermal waves
depth at which the temperature variation below a modulated heated surface is still measurable.

NOTE In general, the penetration depth is of the order of magnitude of the thermal diffusion length

3.3
modulation frequency
f
frequency at which the intensity of the heating radiation varies periodically

3.4
phase (phase shift) of the thermal wave
$\Delta \Phi$
measure of the temporal delay of the temperature oscillation relative to the excitation for periodic-harmonic heating processes

NOTE See Equation 3.

3.5
photothermal efficiency
η
proportion of the incident radiation intensity that is converted into heat

NOTE In most technical applications it is approximately identical to the absorption.

3.6
thermal diffusion length
μ
characteristic length of the thermal diffusion with pulsed heating or periodically modulated heating, where the temperature amplitude has decreased to about 1/e or 37 %

NOTE 1 1/e, with natural number e = 2,71828.

NOTE 2 See Equation 4.

3.7
thermal diffusion time
τ
characteristic time that a thermal wave or a temperature pulse requires for penetrating a layer of finite thickness

NOTE See Equation 7.

3.8
thermal diffusivity
α
thermal parameter characterizing heat propagation in a body with time-dependent heating

NOTE See Equation 6.

3.9
thermal effusivity
e
thermal parameter determining the surface temperature of a body with time-dependent heating

NOTE See Equation 5.

3.10
thermal wave
spatiotemporally variable temperature field that is set up in a body (or medium) with time-dependent heating and is described by the heat conduction equation

NOTE 1 see Equation 1.

NOTE 2 The thermal wave is generated in one limiting case by a periodic-harmonic excitation, in the other limiting case by a pulsed excitation.

3.11
thermal reflection coefficient
R_{ls}
thermal parameter that is a degree of the reflection of the thermal wave at the boundary interface between two layers of different effusivity and thus describes the heat transfer across this boundary interface

NOTE See Equation 8.