



International
Standard

ISO 23131-3

**Ellipsometry —
Part 3:
Transparent single layer model**

Ellipsométrie —

Partie 3: Modèle de couche unique transparente

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Contents

	Page
Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms, definitions and symbols	1
3.1 Terms and definitions	1
3.2 Symbols and abbreviated terms	1
4 Transparent single layer model	2
4.1 Optical path	2
4.2 Assumptions	3
4.2.1 General	3
4.2.2 Deviations from model assumption M1	4
4.2.3 Deviations from model assumption M2	4
4.2.4 Deviations from model assumption M3	4
4.2.5 Deviations from model assumption M4	5
4.2.6 Deviations from model assumption M5	5
4.2.7 Deviations from model assumption M6	5
4.2.8 Deviations from model assumption M7	5
4.2.9 Deviations from model assumption S1	5
4.2.10 Deviations from model assumption S2	6
4.3 Special characteristics of the transparent single layer model	6
4.4 Validation	7
4.5 Measurement uncertainty	8
4.5.1 Measurement uncertainty of the ellipsometric transfer quantities Ψ and Δ	8
4.5.2 Measurement uncertainty u_d of the layer thickness d	9
5 Test report	12
Annex A (informative) Additions to the transparent single layer model	13
Bibliography	29
https://standards.iteh.ai/catalog/standards/iso/0559573c-924d-46cf-82c8-e41573138c37/iso-23131-3-2026	

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Introduction

The ellipsometry measuring method is a phase-sensitive reflection technique using polarized light in the optical far-field. Ellipsometry has been established as a non-invasive measuring method in the field of semiconductor technology, in particular the field of integrated production. The method was originally conceived as a single-wavelength measuring method, then as a multiple-wavelength and later as a spectroscopic measuring method.

Ellipsometry can be used to determine optical or dielectric constants of any material as well as the layer thicknesses of at least semi-transparent layers or layer systems. Ellipsometry is an indirect measuring method, the analysis of which is based on model optimization. The measurands, which differ according to the procedural principle, are converted into the ellipsometric transfer quantities Ψ (psi, amplitude information) and Δ (delta, phase information). The physical target quantities of interest (optical or dielectric constants, layer thicknesses) are determined based on these measurands by means of a parameterized fit.

Ellipsometry shows a high precision regarding the ellipsometric transfer quantities Ψ and Δ , which can be equivalent to a layer thickness sensitivity of 0,1 nm for ideal layer substrate systems. As a result, the measuring method can detect even the slightest discrepancies in surface characteristics. This is closely linked to the homogeneity and the isotropy of the material surface. In order to achieve high precision, carrying out measurements at the exact same measuring point is a prerequisite for inhomogeneous materials. The same applies to the orientation of the incident plane relative to the material surface for anisotropic materials.

In the transparent single layer model, a fitting procedure is used to determine the layer thickness d and the refractive index n of the layer while the optical constants of the substrate are known. For ideal transparent materials, it is assumed that $k = 0$. Therefore, fitting only refers to the layer thickness d , which is by definition independent of the wavelength and of the angle of incidence, and the wavelength-dependent refractive index n , which does not depend on the angle of incidence. Consequently, the transparent single layer model allows the determination of the layer thickness and of the refractive index.

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