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Nanotechnologies – Description, measurement and dimensional quality parameters of artificial gratings

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

NANOTECHNOLOGIES – DESCRIPTION, MEASUREMENT AND DIMENSIONAL QUALITY PARAMETERS OF ARTIFICIAL GRATINGS

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Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 62622, which is a technical specification, has been prepared within the joint working group 2 of IEC technical committee 113 and ISO technical committee 229.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
113/133/DTS	113/143/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table. In ISO, the standard has been approved by 16 member bodies out of 16 having cast a vote.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- transformed into an International Standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A Bilingual version of this publication may be issued at a later date.

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INTRODUCTION

Artificial gratings play an important role in the manufacturing processes of small structures at the nanoscale as well as characterization of nano-objects.

For example, in high volume manufacturing of semiconductor integrated circuits by means of lithography techniques, grating patterns on the photomask and the silicon wafer are optically probed and the resulting optical signal is analyzed and used for relative alignment purposes of mask to wafer in the different lithographic production steps in the wafer-scanner production tools. In semiconductor manufacturing as well as in other manufacturing processes requiring high positioning accuracy at the nanoscale, often length or angular encoder systems based on artificial gratings are used to provide position feedback of moving axes. Another area of application for artificial gratings in nanotechnology is their use as calibration standards for high resolution microscopes, like scanning probe microscopes, scanning electron microscopes or transmission electron microscopes which are necessary tools for the characterization of nanoscale structures.

The quality of the artificial gratings used for position feedback generally influences the achievable accuracy of alignment systems or positioning systems in manufacturing tools. This also holds for the application of artificial gratings as standards for calibration of image magnification of high resolution microscopes, where the quality of the grating plays an important role in the achievable calibration uncertainty of the standard and thus for the attainable measurement uncertainty of the microscope.

This technical specification concentrates on specifying quality parameters, expressed in terms of deviations from nominal positions of grating features, and provides guidance on the application of different categories of measurement and evaluation methods to be used for calibration and characterization of artificial gratings

NANOTECHNOLOGIES – DESCRIPTION, MEASUREMENT AND DIMENSIONAL QUALITY PARAMETERS OF ARTIFICIAL GRATINGS

1 Scope

This technical specification specifies the generic terminology for the global and local quality parameters of artificial gratings, interpreted in terms of deviations from nominal positions of grating features, and provides guidance on the categorization of measurement and evaluation methods for their determination.

This specification is intended to facilitate communication among manufacturers, users and calibration laboratories dealing with the characterization of the dimensional quality parameters of artificial gratings used in nanotechnology.

This specification supports quality assurance in the production and use of artificial gratings in different areas of application in nanotechnology. Whilst the definitions and described methods are universal to a large variety of different gratings, the focus is on one-dimensional (1D) and two-dimensional (2D) gratings.

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/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO/TS 80004-1:2010, *Nanotechnologies – Vocabulary – Part 1: Core terms*