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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



47/2911/CD

COMMITTEE DRAFT (CD)

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DATE OF CIRCULATION: 2025-03-07	CLOSING DATE FOR COMMENTS: 2025-05-02
SUPERSEDES DOCUMENTS: 47/2859/CD, 47/2891/CC	

IEC TC 47 : SEMICONDUCTOR DEVICES	
SECRETARIAT: Korea, Republic of	SECRETARY: Mr Cheolung Cha
OF INTEREST TO THE FOLLOWING COMMITTEES:	HORIZONTAL FUNCTION(S):
ASPECTS CONCERNED:	

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TITLE:
Semiconductor devices - Non-destructive recognition criteria of defects in silicon carbide homoepitaxial wafer for power devices - Part 5: Test method for defects using X-ray topography

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SEMICONDUCTOR DEVICES –
NON-DESTRUCTIVE RECOGNITION CRITERIA OF DEFECTS IN SILICON
CARBIDE HOMOEPITAXIAL WAFER FOR POWER DEVICES –****Part 5: Test method for defects using X-ray topography****FOREWORD**

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IEC 63068 has been prepared by IEC technical committee 47: Semiconductor devices. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

125 Results of evaluating defects on silicon carbide homoepitaxial wafer by test methods using
126 optical inspection and/or photoluminescence often depend on examined wafer conditions such
127 as surface morphology and spatial variation of impurity concentration, and thus need human
128 visual confirmation of the results after inspection using equipment. In particular, micropipe, TSD,
129 TED and particle inclusion that belong to different defect classes but show similar visual
130 features should be evaluated by other test methods such as X-ray topography to inspect defect
131 classes more accurately.

132 This part of IEC 63068 provides definitions and guidance in use of X-ray topography for
133 detecting defects in silicon carbide (SiC) homoepitaxial wafers.

134

SEMICONDUCTOR DEVICES – NON-DESTRUCTIVE RECOGNITION CRITERIA OF DEFECTS IN SILICON CARBIDE HOMOEPITAXIAL WAFER FOR POWER DEVICES –

Part 5: Test method for defects using X-ray topography

1 Scope

This part of IEC 63068 provides definitions and guidance in use of X-ray topography inspection system for detecting defects in silicon carbide (SiC) homoepitaxial wafers. Additionally, this part exemplifies X-ray topographic images to enable the detection and categorization of defects in SiC homoepitaxial wafers.

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.

IEC 63068-1:2019, *Semiconductor devices – Non-destructive recognition criteria of defects in silicon carbide homoepitaxial wafer for power devices – Part 1: Classification of defects*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 63068-1:2019 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1 silicon carbide SiC

semiconductor crystal composed of silicon and carbon, which exhibits a large number of polytypes such as 3C, 4H, and 6H

Note 1 to entry: A symbol like 4H gives the number of periodic stacking layer (2, 3, 4,...) and the crystal symmetry (H = hexagonal, C = cubic) of each polytype.

[SOURCE: IEC 63068-1:2019, 3.1]

3.2

4H-SiC

SiC crystal showing a hexagonal symmetry, in which four Si-C layers are periodically arranged along the crystallographic c-axis

Note 1 to entry: The crystal structure of 4H-SiC is similar to wurtzite with a unit cell having four periodical occupied sites along the <0001> direction.

[SOURCE: IEC 63068-1:2019, 3.3]

3.3

X-ray topography

XRT

method of assessing extended defects in a crystal, where a two-dimensional intensity profile of an X-ray beam diffracted by a crystal lattice is recorded

Note 1 to entry: The diffraction condition in X-ray topography is characterized by a diffraction vector $\mathbf{g}$.

Note 2 to entry: XRT is also known as X-ray diffraction imaging (XRDI).

[SOURCE: IEC 63068-1:2019, 3.47, modified – The part of definition has been modified.]

3.4

X-ray topographic imaging

XRT imaging

technique for capturing, processing and analysing diffraction images of a crystal using an X-ray source, X-ray optics, a goniometer system, an optical image sensor and computer systems

3.5

diffraction condition

geometrical condition how an X-ray beam is reflected by a crystal, denoted as hkl reflection, defined by the periodic three-dimensional arrangement of atoms in the crystal

Note 1 to entry: Scattering vector of the X-ray beam is perpendicular to the $(h/n \ k/n \ l/n)$ plane, where n is the greatest common divisor of h , k , and l .

Note 2 to entry: In 4H-SiC showing a hexagonal symmetry, four-digit indices, $hkil$, are frequently used, where $h + k + i = 0$.

3.6

X-ray source

system which generates and emits X-rays, comprising a high-voltage power supply unit and an X-ray tube consisting of a vacuum cavity containing a target material and a filament

Note 1 to entry: The X-ray source for a laboratory system uses simple substance such as copper as a target material.

3.7

characteristic X-ray beam

X-ray beam showing the line spectrum of wavelengths unique to the constituent elements of the target material

3.8

X-ray optics

optical components which shape and filter an X-ray beam that travels to a test wafer

3.9

crystal monochromator

X-ray optic to select a defined wavelength of the X-ray beam for further purpose on a dedicated instrument

3.10

multilayer collimating mirror

X-ray optic having a multilayer structure that filters wavelength of X-rays and collimates the beam