BS IEC 63068-1:2019

BSI Standards Publication

Semiconductor devices – Non-destructive recognition criteria of defects in silicon carbide homoepitaxial wafer for power devices

Part 1: Classification of defects

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National foreword

This British Standard is the UK implementation of IEC 63068-1:2019.

The UK participation in its preparation was entrusted to Technical Committee EPL/47, Semiconductors.

A list of organizations represented on this committee can be obtained on request to its secretary.

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CONTENTS

FOREWORD 3
INTRODUCTION 5
1 Scope 6
2 Normative references 6
3 Terms and definitions 6
4 Classification of defects 10
4.1 General 10
4.2 Description of the defect classes 11
4.2.1 Examples of defects 11
4.2.2 Point defect 11
4.2.3 Micropipe 11
4.2.4 TSD 12
4.2.5 TED 13
4.2.6 BPD 14
4.2.7 Scratch trace 15
4.2.8 Stacking fault 16
4.2.9 Propagated stacking fault 17
4.2.10 Stacking fault complex 18
4.2.11 Polytype inclusion 19
4.2.12 Particle inclusion 20
4.2.13 Bunched-step segment 21
4.2.14 Surface particle 22
4.2.15 Others 22
Bibliography 23

Figure 1 – Micropipe 12
Figure 2 – TSD 13
Figure 3 – TED 14
Figure 4 – BPD 15
Figure 5 – Scratch trace 16
Figure 6 – Stacking fault 17
Figure 7 – Propagated stacking fault 18
Figure 8 – Stacking fault complex 19
Figure 9 – Polytype inclusion 20
Figure 10 – Particle inclusion 21
Figure 11 – Bunched-step segment 22

Table 1 – Classification of defects 11

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

Part 1: Classification of defects

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International Standard IEC 63068-1 has been prepared by IEC technical committee 47: Semiconductor devices.

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

CDV	Report on voting
47/2474/CDV	47/2521A/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

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

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A list of all parts in the IEC 63068 series, published under the general title *Semiconductor devices – Non-destructive recognition criteria of defects in silicon carbide homoepitaxial wafer for power devices*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://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.

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

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INTRODUCTION

Silicon carbide (SiC) is widely used as a semiconductor material for next-generation power semiconductor devices. SiC, as compared with silicon (Si), has superior physical properties such as a higher breakdown electric field, higher thermal conductivity, lower thermal generation rate, higher saturated electron drift velocity, and lower intrinsic carrier concentration. Their attributes realize SiC-based power semiconductor devices with faster switching speeds, lower losses, higher blocking voltages, and higher temperature operation relative to standard Si-based power semiconductor devices.

SiC-based power semiconductor devices are not fully realized due to high costs, low yield, and perceived reliability concerns. One of the serious issues lies in the defects existing in SiC homoepitaxial wafers. Although an effort of decreasing defects in the SiC homoepitaxial layer is actively implemented, there are a number of defects (approximately 1 000 defects/cm^2) in commercially available SiC homoepitaxial wafers. Therefore, it is indispensable to establish an international standard regarding the quality assessment of SiC homoepitaxial wafers.

The IEC 63068 series of standards is planned to comprise Part 1, Part 2, and Part 3, as detailed below. The outline of this Part 1 is to list, illustrate and provide reference for various characteristic features and defects that are observed on SiC homoepitaxial wafers of crystallographic polytype 4H used in high-power semiconductor device manufacturing.

Part 1: Classification of defects

Part 2: Test method for defects using optical inspection

Part 3: Test method for defects using photoluminescence

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

Part 1: Classification of defects

1 Scope

This part of IEC 63068 gives a classification of defects in as-grown 4H-SiC (Silicon Carbide) epitaxial layers. The defects are classified on the basis of their crystallographic structures and recognized by non-destructive detection methods including bright-field OM (optical microscopy), PL (photoluminescence), and XRT (X-ray topography) images.

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.

There are no normative references in this document.

3 Terms and definitions

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

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://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 layers (2, 3, 4,…) and the crystal symmetry (H = hexagonal, C = cubic) of each polytype.

3.2
3C-SiC
SiC crystal with zinc blende structure, in which three Si-C layers are periodically arranged along the <111> direction

3.3
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.

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