

SEMI M81-0418

GUIDE TO DEFECTS FOUND ON MONOCRYSTALLINE SILICON CARBIDE SUBSTRATES

This Standard was technically approved by the Compound Semiconductor Materials Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on December 13, 2017. Available at www.semiviews.org and www.semi.org in April 2018; originally published June 2011.

1 Purpose

1.1 The purpose of this Guide is to list, illustrate and provide reference for various characteristic features and defects that are seen on silicon carbide wafers. Recommended practices for observation are referenced as far as available standards. The artifacts described in this Guide are intended to support the development of test methods and to support the content of SEMI M55.

2 Scope

2.1 Observed defects on monocrystalline SiC substrates, which are of potential relevance for industrial application are identified and described on the basis of examples, mainly by photos, pictures and other relevant data for these defects.

2.2 The defect terminology is reviewed and adapted where necessary.

2.3 This Document does not cover epitaxial layers grown on SiC substrates.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 Defects, structures, features or artifacts revealed or enhanced by the referenced methods and exhibited in this Guide must be carefully interpreted. Unless utmost care is exercised, the identification of the structure may be ambiguous.

4 Referenced Standards and Documents

4.1 SEMI Standards and Safety Guidelines

SEMI M55 — Specification for Polished Monocrystalline Silicon Carbide Wafers

SEMI M83 — Test Method for Determination of Dislocation Etch Pit Density in Monocrystals of III-V Compound Semiconductors

4.2 ASTM Standard¹

ASTM F1404-92(2007) — Test Method for Crystallographic Perfection of Gallium Arsenide by Molten Potassium Hydroxide (KOH) Etch Technique (Withdrawn 2016)

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

¹ ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA; Telephone: +1.610.832.9585, Fax: +1.610.832.9555, <http://www.astm.org>

5 List of Defects

Table 1 List of Defects

<i>Defect/Keyword</i>	<i>Remark</i>	<i>Figure(s)</i>
micropipe	bulk defect, no special preparation	1, 3, 6
planar defect	bulk defect, no special preparation	2, 3
crystallite, crystallite defect	bulk defect, no special preparation	6
polytypes, polytype defect	bulk defect, no special preparation	4, 5
crossed polarizers	method	5, 6
edge chip	surface feature	7
indent	surface feature	7
pit	surface feature	8
scratch, microscopic scratch	surface feature	9
crack	surface feature	10
large hexagonal etch pit	KOH etched surface, see also SEMI M83 or ASTM F1404	11, 12
basal plane dislocation (BPD)	KOH etched surface, see also SEMI M83 or ASTM F1404	13, 15
threading dislocation (TSD, TED)	KOH etched surface, see also SEMI M83 or ASTM F1404	14, 15
screw dislocation (SD)	KOH etched surface, see also SEMI M83 or ASTM F1404	11, 14
edge dislocation (ED)	KOH etched surface, see also SEMI M83 or ASTM F1404	14

6 Bulk Features (no special preparation)

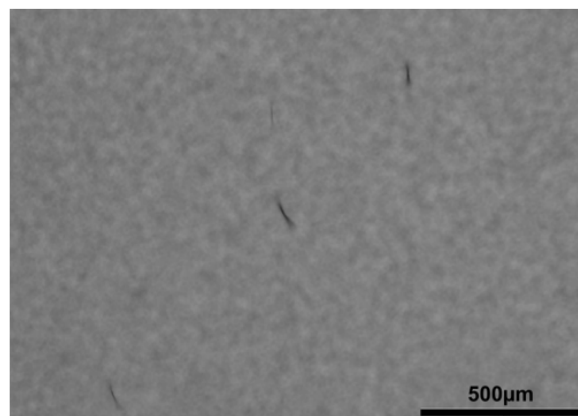


Figure 1
Micropipes, optical microscope, transmission mode, focus in bulk.
Material: 4H, 4deg off, Si-face.

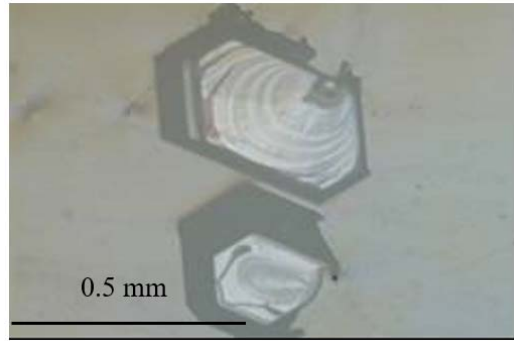
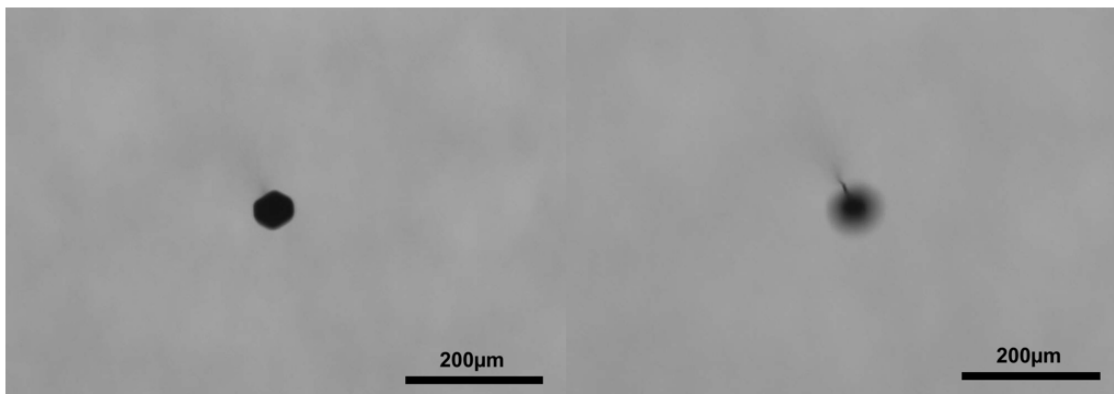


Figure 2
Planar Defect (void or negative crystal in bulk), optical microscope, transmission mode, focus in bulk.
Material: 4H, 4 deg off, Si face.



#1 Optical microscope, transmission mode, different depth of focus in the material.

Figure 3
Planar Defect with micropipe attached on top left (optical microscope, transmission mode, different depth of focus in the material).
Material: 4H, 4deg off, Si-face, n-type.

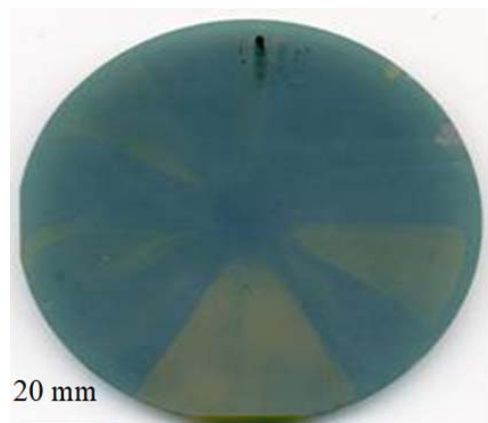


Figure 4
Polytypes (foreign polytypes, polytype defect): deviating yellowish color due to 15R or 21R or similar modification on n-type material. The affected area may be much smaller in the order of 0.1 mm².
Material: 6H, n-type.