



SEMI China XXX Std. Technical Committee

SNARF Specification of High-purity silicon carbide powder for SiC Substrate

SiC Substrate Task Force

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STANDARDS

GTC Members Preview Period

took place between _____ and _____ before approval at the TC Chapter Meeting

背景信息 Rationale

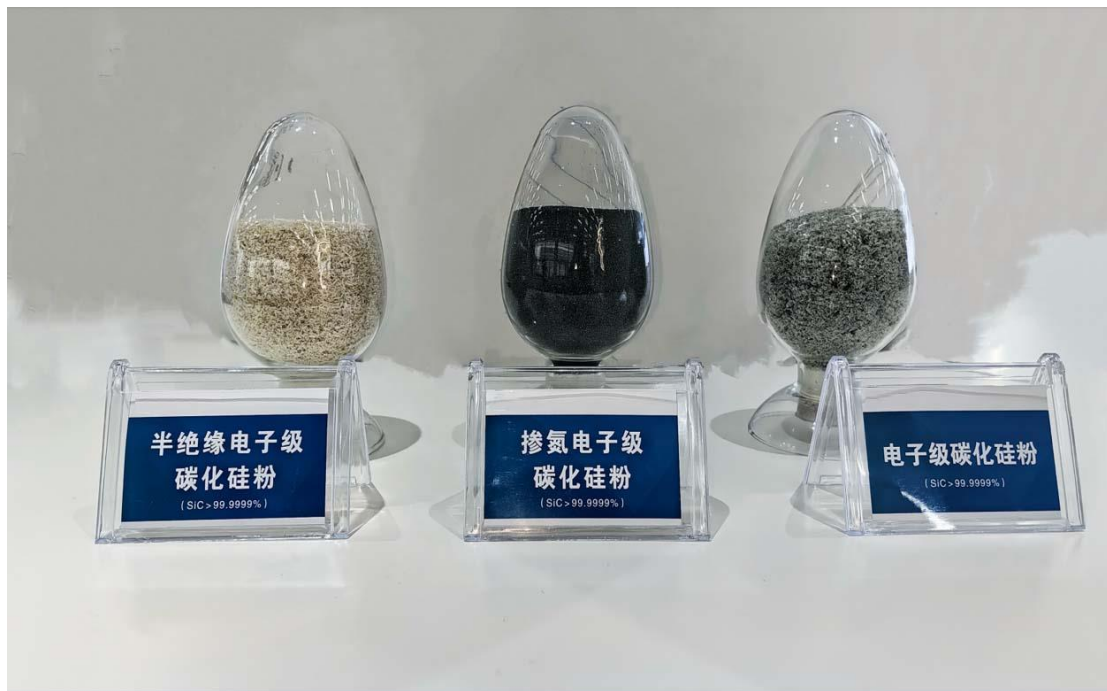
碳化硅(SiC)半导体材料是第三代半导体材料的代表之一，因其禁带宽度大、临界电场高、导热率高、电子迁移速度高、化学稳定性高、热稳定性好的等性质，被广泛应用在高温高压高频的场景中。

目前制作器件用的碳化硅单晶衬底材料一般采用PVT法，SiC粉料用作生长SiC单晶的原材料。研究表明，SiC粉体的纯度以及其他参数如粒度和晶型等对PVT法生长SiC单晶晶体质量乃至后续制作的器件质量都有非常大的影响。

Silicon carbide (SiC) crystal is a promising material for high-temperature, high-power, high-frequency applications, owing to its superior properties, such as wide band gap, high critical breakdown electric field, large thermal conductivity, high electron mobility, high chemical stability, low thermal expansion coefficient and so on. SiC powder can be used as a source material for the growth of SiC single crystals through physical vapor transport technique. The results show that the purity of SiC powder and other parameters such as particle size and crystal form have a great impact on the quality of SiC single crystal crystals grown by PVT method and the quality of power devices.



背景信息 Rationale



SiC 粉体的合成方法有固相法、液相法和CVD气相法,其中固相法（自蔓延高温合成法）原料广泛,制备过程简单,产量高,是工业上制备生产高纯 SiC 粉体的主要方法。在该工艺过程中,SiC 粉体的纯度、粒径、晶型受到合成温度、时间、原料配比等多种因素的影响。

为了保证PVT生长碳化硅晶体的质量,促进其技术进步和产品质量的提高,更好地满足合成工艺的要求,有必要制定高纯碳化硅粉料的技术标准,这也为产业下游的发展提供了必要的条件。

The synthesis methods of SiC powder include solid phase method, liquid phase method and CVD method, among which the solid phase method (self-propagating high-temperature synthesis method) has a wide range of raw materials, simple preparation process and high output, which is the main method for the preparation and production of high-purity SiC powder in industry. In the process, the purity, particle size, and crystal form of SiC powder are affected by various factors such as synthesis temperature, time, and raw material ratio.

工作范围 Working Scope

术语及定义

Terms &
Definitions

技术要求

Technical
Requirements

试验方法

Test Methods

检测规则

Inspection
Rules

标志、包装、
运输和贮存

marking, packaging,
transportation and
storage

...

本文件规定了高纯碳化硅粉体的术语定义、技术要求、试验方法、检验规则、标志、包装、运输和贮存等。
本文件适用于碳化硅纯度 $\geq 6\text{ N}$ (99.9999 wt%) 的晶体生长用高纯碳化硅粉体。

This document specifies the terms&definitions, technical requirements, test methods, inspection rules, marking, packaging, transportation and storage of high-purity silicon carbide powder

This document applies to high-purity silicon carbide powders for crystal growth with a purity of $\geq 6\text{ N}$ (99.9999 wt%) for silicon carbide.

工作范围 Working Scope

高纯碳化硅粉体 high-purity silicon carbide powder

指具有极高纯度的碳化硅，通常要求碳化硅粉体接近100%，并且少含杂质（如铁、硼、磷等），以确保最终碳化硅晶体的纯净度要求。晶体生长用高纯碳化硅粉体应为白色颗粒、墨绿色颗粒或者浅色颗粒，无结团。

粒度 granularity

指碳化硅颗粒粒径大小的分布范围及其均匀性。通常采用网孔尺寸、平均直径或者累积频率等方式进行描述。

粒度标记		上筛			主筛			下筛		
		网孔尺寸		筛上物≤	网孔尺寸		筛上物≥	网孔尺寸		筛下物≤
粒径	目数	mm	μm	质量分数，%	mm	μm	质量分数，%	mm	μm	质量分数，%
2-4 mm	5-10目	4.00	-	30	2.00	-	55	2.00	-	15
0.8-2 mm	10-24目	2.00	-	30	-	850	55	-	850	15
0.4-0.8 mm	24-45目	-	850	30	-	425	55	-	425	15
0.2-0.4 mm	35-80目	-	425	30	-	212	55	-	212	15

工作范围 Working Scope

杂质元素

指在粉体中除主要成分碳化硅（Si C）以外的其他元素，包括硼、磷、铝、铁、钒、硼、钛、钨等元素。

氮含量

半绝缘型高纯碳化硅粉体氮含量 $< 5 \times 10^{16} \text{ atom/cm}^3$

二次离子质谱法（SIMS）

通过高能量的一次离子束轰击样品表面，使样品表面的分子吸收能量而从表面发生溅射产生二次离子,通过质量分析器收集、分析得到关于样品表面信息的图谱。

辉光放电质谱法（GDMS）

利用辉光放电源作为离子源与质谱仪器联接进行质谱测定的一种分析方法。用于对固体导电材料直接进行痕量及超痕量元素分析。

杂质元素	指标要求（ppm）
B	< 0.01
Al	< 0.05
Ti	< 0.05
Fe	< 0.05
P	< 0.05
V	< 0.05
W	< 0.05

工作范围 Working Scope

		备注
检验规则	出厂检验项目	外观、粒度、杂质元素含量等
	型式检验项目	堆积密度、氮含量、纯度等
标志、包装运输和贮藏	标签信息	制造厂名称或商标、产品名称、产品数量、重量、生产日期、执行标准代号、批号、质量检验合格证明、检验员代号、使用和贮存注意事项等；
	包装	产品包装宜为两层，内层为洁净的高纯粉体产品专用塑料袋，外层瓦楞纸箱 产品封装前，应将塑料袋中的空气排尽，并用氮气置换三次后用热塑封边
	运输	装卸货时，应轻拿轻放，不应扔摔、撞击、挤压等。运输过程中应防雨、防尘、防倒置等，产品不应与油、酸、碱、有毒、有害物质混装混运。

标准制定成员

主编单位：连科半导体有限公司

参编单位：建议浙大科创中心、中宜创芯、天岳先进、中电化合物、北方华创、天科合达等

时间节点计划

- 1 2024年1月-2024年12月前期准备工作，对高纯碳化硅粉料各项参数进行确认
- 2 2024年12月冬季会议上提交SNARF
标准名称：《Specification of High-purity silicon carbide powder for SiC Substrate》
- 3 2024年12月开始组建编制组，对高纯碳化硅粉料进行技术调研，并开始标准的初稿撰写
- 4 2025年1月-10月工作组标准讨论及制定，形成标准draft

Liaison

List SEMI Global Technical Committees, TC Chapters, Subcommittees, or Task Forces in your or other Regions/Locales that should be kept informed regarding the progress of this activity.

Liaison

List any planned Type I Liaisons with external nonprofit organizations (e.g., SDO) that should receive Draft Documents from Standards staff for feedback during this activity and be notified when the Letter Ballot is issued (refer to Procedure Manual § 7).

Liaison

Intercommittee Ballots (check one)

- ☐ Will be issued – **identify the recipient global technical committee(s):**
- ☐ Will not be issued

Safety Consideration

The resulting Document is expected (Check one):

☐ to be a Safety Guideline

✓ **NOT to be a Safety Guideline**

NOTE FOR 'to be a Safety Guideline': When all safety-related information is removed from the Document, the Document is NOT technically sound and complete – Refer to § 15.1 of the *Regulations* for special procedures to be followed.

NOTE FOR 'NOT to be a Safety Guideline': When all safety-related information is removed from the Document, the Document is still technically sound and complete.

Intellectual Property Consideration

a: For a new Standard or Safety Guideline and for any part to be modified or added in a Revision of published Standards and Safety Guidelines (Check one):

☒ the use of patented technology is NOT required.

☐ patented technology is intended to be included in the proposed Standard(s) or Safety Guideline(s).

(If the second box is checked, check one):

☐ Letter of Intent received

☐ Letter of Intent not received

Intellectual Property Consideration

b: For Revision, Reapproval, Reinstatement, or Withdrawal of existing Standard(s) and Safety Guideline(s) (Check one):

- ☒ **there is no known material patented technology necessary to use or implement the Standard(s) and Safety Guideline(s)**
- ☐ **there is previously known material patented technology necessary to use or implement the Standard(s) and Safety Guideline(s)**

Intellectual Property Consideration

c: The body of the Document and any Appendices, Complementary Files, Related Information sections, or Various Materials that may or may not be a part of the Document by reference (Check one):

☐ will incorporate Copyrighted Item

✓ the incorporation of Copyrighted Item will NOT be required

NOTE FOR 'the use of patented technology or the incorporation of Copyrighted Item(s) is NOT required': If in the course of developing the Document, it is determined that the use of patented technology or Copyrighted Item(s) is necessary for the Document, the provisions of *Regulations* § 16 must be followed.

NOTE FOR 'will incorporate Copyrighted Item': A copyright release letter must be obtained from the copyright owner prior to publication.

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STANDARDS