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Test method for the thickness of silicon carbide epitaxial layers - Infrared reflectance method

碳化硅外延层厚度的测试 红外反射法

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part

1.Structure and Drafting Rules of Standardization Documents" Drafting. Please note that some content in this document may be subject to patents. The publisher of this document assumes no responsibility for identifying patents. This document is jointly developed by the National Semiconductor Equipment and Materials Standardization Technical Committee (SAC/TC203) and the National Semiconductor Equipment and Materials Standards It was jointly proposed and coordinated by the Materials Sub-Technical Committee of the Chemistry Technical Committee (SAC/TC203/SC2). This document was drafted by: Anhui Changfei Advanced Semiconductor Co., Ltd., Anhui Xinle Semiconductor Co., Ltd., Hebei Puxing Electronic Technology Co., Ltd. Co., Ltd., Guangdong Tianyu Semiconductor Co., Ltd., Nanjing Guosheng Electronics Co., Ltd., Zhejiang Xinke Semiconductor Co., Ltd., Bruker (Beijing) Technology Co., Ltd., Institute of Semiconductors, Chinese Academy of Sciences, and Institute of Nonferrous Metals Technology and Economics Co., Ltd. The main drafters of this document. Niu Yingxi, Liu Min, Yuan Song, Zhao Lixia, Ding Xiongjie, Wu Huiwang, Qiu Guangyin, Li Suqing, Li Jingbo, Zhang Huijuan, Zhao Yue, Peng Tiekun, Lei Haodong, Yan Guoguo. Testing of silicon carbide epitaxial layer thickness by infrared reflection method

1 Scope

China's national method for measuring the thickness of silicon carbide epitaxial layers by infrared reflectance. Silicon carbide power devices are built in an epitaxial layer grown on a SiC substrate, and that layer's thickness together with its doping determines the voltage the device will block - which is the property the device is sold on. Measuring it non-destructively is possible because the epitaxial layer and the substrate differ in free carrier concentration and therefore in refractive index at infrared wavelengths, so the interface reflects: the reflected beam interferes with the one from the surface, and the resulting fringe pattern gives the thickness directly. The measurement takes seconds, needs no contact and can be

mapped across a wafer, which is what makes it a production control rather than a laboratory technique. SiC devices are the enabling component of electric vehicle traction inverters and fast chargers, which is why this matters commercially.

This document describes a method for testing the thickness of silicon carbide epitaxial layers using infrared reflection. This document is applicable to silicon carbide substrates with n-type doping concentration greater than 1x1018cm-3 and homogeneous doping concentration less than 1x1016cm-3. Testing of homogeneous silicon carbide epitaxial layer thickness, the test range is 3μm~200μm.

2 Normative reference documents

The contents of the following documents constitute essential provisions of this document through normative references in the text. Among them, the dated quotations For undated referenced documents, only the version corresponding to that date applies to this document; for undated referenced documents, the latest version (including all amendments) applies to this document.

GB/T 6379.2 Accuracy of measurement methods and results (correctness and precision) Part

2.Determination of repeatability of standard measurement methods Basic methods of sex and reproducibility

GB/T 14264 Semiconductor material terminology

3 Terms and definitions

The terms and definitions defined in GB/T 14264 apply to this document.

4 Method Principles

The difference in optical constants between the silicon carbide substrate and the epitaxial layer causes optical interference of continuous maximum and minimum characteristic spectra in the reflection spectrum of the sample. Phenomenon, calculated based on the extreme wave number of the interference fringe in the reflection spectrum, the optical constants of the epitaxial layer and the substrate, and the incident angle of the infrared beam on the sample. Find the corresponding epitaxial layer thickness. The schematic diagram of the thickness detection principle of the silicon carbide epitaxial layer is shown in Figure 1.