SiC MATERIALS AND DEVICES

Volume 1

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PREFACE

Silicon carbide has been known investigated since 1907 when Captain H. J. Round demonstrated yellow and blue emission by applying bias between a metal needle and a SiC crystal. In 1923, a Russian scientist, Oleg Losev, discovered two types of light emission from SiC – the emission that we would now call "pre-breakdown" light and the electroluminescent emission. The potential of using SiC in semiconductor electronics was already recognized about a half of century ago. The most remarkable SiC properties are:

- Wide band gap (3 to 3.3 eV for different polytypes)
- Very large avalanche breakdown field (2.5 – 5 MV/cm)
- High thermal conductivity (3 – 4.9 W/cm K)
- High maximum operating temperature (up to 1,000 °C)
- Chemical inertness and radiation hardness

However, some of these potential advantages also cause exceptional technological difficulties in getting silicon carbide material to reach the device quality, and it has taken a few decades to travel the road from basic research to commercialization.

The breakthrough was reached in early 1990s, when nearly all basic semiconductor devices – p-n diodes, Schottky diodes, Metal Oxide Semiconductor Field Effect Transistor (MOSFETs), Metal Semiconductor Field Effect Transistor (MESFETs), bipolar junction transistors, thyristors, IMPATT diodes, and solar blind photodetectors – have been successfully demonstrated.

The first commercial SiC devices – power switching Schottky diodes and high temperature MESFETs – are now on the market.

For nitride based devices, silicon carbide has become a substrate of choice, because of its excellent thermal conductivity and decent lattice match. This includes both electronic and blue light emitting diodes and lasers, and, together with nitride based semiconductors, silicon carbide is now in the forefront of the semiconductor research.

The contributors to this two-volume book are recognized leaders in SiC technology and materials and device research. They provide complete and up-to-date review of the state-of-the-art.

This first volume has chapters on SiC material properties (Chapter 1), SiC homo- and hetero-epitaxy (Chapter 2), Ohmic contacts to SiC (Chapters 3), Schottky barrier diodes (Chapter 4), high power p-i-n rectifiers (Chapter 5), microwave SiC diodes (Chapter 6), SiC thyristors (Chapter 7), and SiC static induction transistors (Chapter 8).

This book will be useful for technologists, scientists, engineers, and graduate students who are working on silicon carbide or other wide band gap materials and devices. The book can also be used as a supplementary textbook for graduate courses on silicon carbide and wide band gap semiconductor technology.

Michael Shur
Sergey Rumyantsev
Michael Levinshstein

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