SILICON CARBIDE — MATERIALS, PROCESSING, AND DEVICES

This special issue of the Journal of Materials Research contains articles that were accepted in response to an invitation for manuscripts.

Introduction

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Silicon carbide (SiC) is a developing material with a myriad of new applications, ranging from high-power electronics to harsh environment sensors and, more recently, biomedical devices. One of the unique properties of SiC is that it can be grown in numerous crystal forms, called polytypes, with two dominant hexagonal forms, designated 4H- and 6H-SiC, and one cubic form, designated 3C-SiC. While each of these polytypes has been actively researched for some time, there seems to be a divergence of usage as of late. 6H-SiC, the first polytype to achieve commercial substrate production, is mainly used as a high-quality substrate for group III-V optoelectronic devices such as blue LEDs and laser diodes. This is due to the ability to realize a conductive substrate as compared with sapphire which is also used in LED lighting but requires the devices to be in a lateral (surface) geometry as opposed to a more advantageous vertical geometry. With the largest energy band gap of all of the principle SiC polytypes, 4H-SiC has found its niche in power electronic devices where Schottky diodes, JFETs and MOSFETs have finally entered the commercial marketplace. This technology is key for most advanced power switching applications such as electric vehicles, HDTV base station transmitters, and so on. Finally the cubic polytype, 3C-SiC, has the significant advantage relative to the other forms of SiC in that it can be heteroepitaxially grown on low-cost, large area and low-defect density Si substrates. As a consequence 3C-SiC is most utilized in the area of robust sensors, such as chemical and hydrogen sensors because it can be micromachined using similar technology to that used for Si MEMS (microelectro-mechanical systems). Indeed, 3C-SiC is also being developed for electronic device applications, and all of the principle devices have been demonstrated in 3C-SiC to date. More exciting still is that 3C-SiC has been proven to be an ideal material for advanced biomedical device applications due to the unique property of both bio- and hemo-compatibility.

While the future for SiC technology is very promising, there are still some materials challenges that must be fully addressed before large-scale adoption can be achieved. In this Focus Issue updates on research related to all of the above applications have been selected so that the reader can best understand the current state of SiC technology as of early 2012. Papers addressing crystal growth, both in bulk and thin-film forms, are included as well as materials characterization, electronic device processing issues and, naturally, electronic device performance. Also included are papers involving SiC MEMS technology as well as biomedical uses of SiC. This Focus Issue is extremely broad in scope and, therefore, has something of interest for everyone who is either engaged in advanced materials and device development or who is considering changing technology to allow for enhanced performance at the systems level. This was the implicit intention of the guest editors, and we sincerely hope that we did not fail in achieving this objective.

Finally, we would like to offer our sincere thanks to both the authors and reviewers of the many high-quality manuscripts submitted to this *JMR* Focus Issue on ***Silicon Carbide —Materials, Processing, and Devices***, as well as the efficient and talented editorial staff who were always willing to provide much appreciated assistance throughout the process.

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