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Semiconductor-Dielectric Interfaces: Structure, Defects and Mobility

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The semiconductor-dielectric interface is the key to a successful MOSFET technology and has played the essential role in the silicon revolution. Wide-band gap materials have presented a challenge to achieve the same degree of interface perfection as silicon, although considerable progress is underway. The SiC/SiO_2 interface is of particular scientific interest in this development because of its close relationship to silicon, both in processing and structure. Silicon carbide itself provides an intriguing scientific platform for understanding such materials structures due to the availability of many poly-types with different band-gaps, access to different crystal faces-polar and non-polar-, and with a fabrication process that is similar to the well-studied silicon structure. This talk will review recent work in understanding in the oxidation process in SiC. We describe the nature of the (heavily) defected intrinsic interface, the use of chemical modification to reduce the interface defect density and the understanding of these processes that emerges employing varying band-gap and crystal-face, within the same bulk material. Systematic use of chemical modification and processing, combined with a careful analysis of interfacial structure, results in significant progress in reducing defects and increasing charge and inversion layer mobility. Collaborators: S. Dhar, J. Williams, S. Pantelides, L. Porter, J. Cooper Supported by DARPA Contract No. N00014-02-1-0628 and ONR DEPSCoR Grant N00014-01-1-0616.