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Materials Science and Engineering Seminar Series

Materials Research at Carnegie Mellon

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"Inhomogeneities and Their Effect on the Electrical Characteristics of Schottky Contacts to n-type 4H-SiC"

Friday, November 11, 2005
11:00 A.M. Seminar in Hamerschlag Hall B131
Refreshments precede seminar at 10:30 A.M. in 2325 Wean Hall

The Schottky contact is a fundamental metal-semiconductor contact, and Schottky diodes are currently one of the few commercially available SiC electronic products. One of the main obstacles to large-scale commercialization of SiC electronic devices is increasing the yield percentage of Schottky contacts to SiC. This research investigates the causes of non-ideal Schottky contacts to SiC epitaxial layers. In the first part of this research, the influence of deep levels on current voltage (I-V) characteristics of Ni Schottky contacts on n-type 4H-SiC grown by either sublimation epitaxy of chemical vapor deposition (CVD) was investigated. While near-ideal contacts were fabricated on both samples, approximately half of the contacts on each sample displayed a "double-barrier," or inhomogeneous barrier height. From deep level transient spectroscopy (DLTS), it was found that the "double-barrier" contacts had a higher concentration of deep levels located within the semiconductor bandgap. Similar "double-barrier" characteristics were observed when 500 contacts were characterized across a single 2-inch n-type 4H-SiC wafer. Cathodoluminescence indicated that specific deep level states are associated with the observed electrical variations. Comparisons of X-ray topographic (XRT) and polarized light microscopy (PLM) images with the I-V data revealed no correlations with specific one-or two-dimensional defects, such as screw dislocations or micropipes. A theoretical model, based on two parallel diodes with different barrier heights, matched the experimental data extremely well, indicating that the "double-barrier" contacts consisted of an inhomogeneous energy barrier caused by defects in the SiC material.

Daniel Ewing received his Bachelor of Science degree in Materials Engineering from Brown University in 2000. He received his MS in Materials Science and Engineering from Carnegie Mellon University in June 2001. He is currently a graduate research assistant working towards his PhD project entitled "Inhomogeneities and Their Effect on Electrical Characteristics of Schottky Contacts to n-type 4H-SiC" under the guidance of Prof. Lisa Porter.