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"Evolution of Extended Defects in PVT-grown 4H-SiC Single Crystals"

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11:00 A.M. Seminar in Hamerschlag B 131
Refreshments precede seminar at 10:30 A.M. in 2325 Wean Hall

The high-voltage high-power silicon carbide (SiC) switching devices are especially susceptible to catastrophic breakdown and long term reliability problems which are caused by the extended crystal defects such as micropipes, stacking faults, and dislocations. Since SiC epilayers are grown on off-cut substrates, most extended defects present in the substrates intersect the wafer surface and propagate into the epilayer. The elimination or reduction of the extended defects in physical vapor transport (PVT) grown SiC boules is, therefore, one of the most fundamental approaches to improve overall reliability of SiC bipolar devices. To do so, it is necessary to understand the behavior and origin of such defects in as-grown SiC bulk crystals.

This work addresses the origin and evolution of two types of the extended defects most frequently observed in PVT-grown SiC single crystals. They are basal plane dislocations (BPDs) and threading edge dislocations (TEDs).

First part of the work identifies the origin of basal plane bending in SiC boules and presents the conclusive experimental evidence of basal plane slip activation during the PVT growth. It will be discussed that the basal plane bending is equivalent to the slip induced BPDs with a partial edge character and a net Burgers vector. The experimental evidence for the large spatial extent of the forces gives strong support to thermoelastic stresses developed during growth providing the driving force for deformation.

Next, the evolution of the TEDs in SiC PVT boules is discussed. Symmetric arrays of the TEDs were observed in the so-called star defect in hexagonal SiC crystals. They were nucleated during the PVT growth and replicated into the active layer during the epitaxy. They are thought to form prismatic dislocation loops produced by the compressive stress fields induced at the defect center.

Jaewon received his Bachelor's degree in Materials Science and Engineering from Korea Advanced Institute of Science and Technology, Daejeon, South Korea in 2002 and his Master's degree in Materials Science and Engineering from Carnegie Mellon University in 2003. He is currently a Ph.D. candidate under the guidance of Prof. Skowronski.