MAR13-2012-020412

Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Defects in Carbon-Based Materials

GERD DUSCHER, The University of Tennesse, Materials Science & Engineering

Two distinctly different carbon based semiconducting materials were investigated as to how point defects can influence the electric properties. SiC is a high power electronic material with high bulk mobility. The interface between SiC and SiO_2 is generally considered to be the cause for the reduced mobility of SiC devices compared to bulk SiC. We investigated this interface with atomic resolution Z-contrast and electron energy-loss spectroscopy. We come to the conclusion that the previously observed interface layer is due to the miscut and does not exhibit any stoichiometric change. The structure of the interface which is limiting the device performance is caused by the steps and facets at the interface introduced by the miscut. We observed a high number of carbon in the oxide right next to the interface. Aberration corrected transmission electron microscopy enabled the investigation of the atomic structure of this highly stepped interface and the impact of geometry and chemistry on the electronic properties of this material. Graphene is an emerging electronic material also with high mobility. We investigated the defects and dopants in graphene were investigated. We observed point and extended defects in this 2D material. Due to the clear observation of all atoms involved, this material can serve as a model material to study point defects directly. We observe a electronegativity doping of substitutional Si. We observed a remarkable resistance to oxidation of a variety of point defects of elements that readily oxidize in normal circumstances. Boron and nitrogen doped graphene was investigated and the exact nature of the dopant sites and interactions will be shown. Generally speaking modern electron microscopy can directly visualize the full atomic structures in geometrically simple materials like graphene. The knowledge of point defects can be the basis to understand the electronic property structure relationship of structurally complex materials like SiC.