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Atomic and Electronic Structure of Dislocation Cores in GaN

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The scanning transmission electron microscope (STEM) allows direct correlation of atomic and electronic structure at critical defects such as dislocations. In the STEM, a Z-contrast image is formed by scanning a beam of atomic dimensions across a thin TEM sample and detecting the total scattering to high angles with an annular detector. The cross section for high angle scattering depends on mean square atomic number, Z. Such an image is incoherent in nature, which allows column positions to be determined to high accuracy without the need for image simulations, even at the cores of threading dislocations. Furthermore, the beam may be stopped on a selected column or columns for electron energy loss spectroscopy. The energy loss spectrum provides details on stoichiometry, and the fine structure and position of the edge onset reflects the local electronic structure. Fine structure can be inverted through theoretical calculations of trial structures. Results will be presented for a variety of dislocation cores.

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