

## **Modification of High Purity N-type Silicon Surfaces by Antimony Delta Doping for Detector Applications**

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Sb delta doping has been explored as a potential back surface treatment for high purity n-type silicon detectors such as PIN diode arrays and Charge Coupled Devices (CCDs). These devices can potentially be used for detection of particles over a wide range of energy. An advantage of high purity silicon devices is that they can be fully depleted, however, this also makes them particularly susceptible to surface effects. The presence of surface states on the back side of an unpassivated device causes unfavorable bandbending that prevents the collection of shallow-penetrating ionizing radiation such as low-energy particles (e.g., electrons < 1 keV) and higher energy photons (in the ultraviolet range <400 nm). Additionally, high leakage current is associated with full depletion coupled with unpassivated surfaces.

The back surface can potentially be engineered by delta doping to eliminate unfavorable bandbending while reducing leakage current. Sb-doped silicon has been grown by Molecular Beam Epitaxy (MBE) at low temperatures (< 450 °C) for compatibility with growth on fully processed devices. The effects of starting surface quality, temperature, growth rate, and Sb flux on epitaxial growth will be discussed and related to device performance.