SiC Schottky Diode for Radiation Detection

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Abstract:

Silicon carbide is a well-known semiconductor with many attributes that make it well suited for radiation detection. Because of its large bandgap (~3.2eV), it offers less leakage current, and a larger temperature range compared to silicon devices. A basic radiation/particle detector can be constructed using a reverse biased SiC diode. When the diode senses a particle of radiation while reverse biased, it will cause a large inrush current with an amplitude proportional to the energy of the particle. The readout circuitry then converts that current pulse into a shaped voltage pulse, which can then be fed into a commercial analog-to digital (ADC) for particle counting. A field plated SiC Schottky diode has been designed, simulated, and fabricated at OSU's cleanroom lab, NanoTech West (NTW), based on initial design and process steps. Preliminary I/V testing has shown that our design and process is functional, however, changes could be made based on our measurements to improve device performance. By looking at the I/V characteristics, radiation response, and scanning electron microscopes (SEM) images and cross-sections, we can glean clues as to how to improve our design and process for future lots. Initial breakdown measurements show that most of the diode breakdowns are occurring at the edge of the field plate. A number of dies have been packaged and wirebonded for radiation response testing. A second SiC Schottky diode lot is planned with an updated design and process flow, with improvements targeting the breakdown voltage and uniformity from die to die, such as adding an oxide densification step. We plan to pair our SiC Schottky diode with our readout circuitry for use in radiation detection.