Abstract: We present the fabricate of single atom devices via direct write nanofabrication using Sandia National Laboratories nanoImplanter. This focused ion beam (FIB) implantation capability is part of Sandi’s Ion Beam Laboratory and is a multi-species 10-100 kV FIB system with a minimum spot size of 10 nm with both mass resolution using an ExB filter and single ion implantation using fast blanking and chopping. The combination of high spatial resolution, variable energy and the ability to implant a range of elements from the periodic table makes this a versatile machine for a range of topics from deterministic seeding of TaOx memristor devices, high resolution ion beam induced charge collection (IBIC) for probing the structure of defect cascades, deterministic single donor devices for quantum computing research, to the formation of individual SiV centers in diamond using in-situ detectors. Here we concentrate on FIB implantation into Si and Diamond devices.

The idea for donor based quantum computing goes back to Kane. We have developed a fabrication pathway that combines FIB with in-situ counted ion detection. We integrate avalanche photodiodes with quantum transport nanostructures and demonstrate low temperature transport in counted samples. Color centers in diamond are used for a range of applications from metrology to single photon sources for secure quantum communication. We demonstrate the ability to deterministically implant ions into photonic nanostructures with high spatial resolution. Separately, we demonstrate single ion detection using an in-situ diamond detector.

A versatile multi-species FIB capability demonstrates utility for a range of applications including the direct write nanofabrication of single atom devices in both silicon and diamond substrates.

Biography: Dr. Bielejec has been a staff member of Sandia’s Ion Beam Laboratory since 2005 where he has concentrated on using ion beam irradiation for both radiation effect testing, as well as, precision nanofabrication.

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