

Path to Deterministic Single Donor Devices using Focused Top-Down Ion Implantation

Edward Bielejec^{*}, N. Bishop and M. S. Carroll

Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185-1056, USA

We present experimental results and fabrication details of an effort at Sandia National Laboratories (SNL) to develop deterministic single ion implanted donor devices for quantum information processing. This program involves development along three parallel tracks – development of single ion detection capability using avalanche photodiodes (APD) detectors, integration with a nanostructured platform and the development of a focused nano-beam for spatially controlled implantation. In this talk we will present details on our newest APD results showing both active and diffused carrier detection for APD detectors integrated into the Si double quantum dot (DQD) process flow. In addition, we will present our newest ion beam work highlighting a new focused nanobeam capability for deterministic implants that we have developed in conjunction with the A&D Corporation. This nanoimplanter (nI) is a 100 kV focused ion beam with a measured spot size of <10 nm and ExB filter allowing for multiple liquid metal sources (including P and Sb) to be used. We will outline both the short-term outlook for combined Si DQD and donor devices using the nI for deterministic implants of both P and Sb ions, as well as, a more long-term exploration of the nI capability.

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.