Fabrication of High Frequency Oersted Lines for Electron Spin Manipulation

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The capability to achieve atomic-scale placement accuracy using Scanning Tunneling Microscopy (STM) offers significant potential for the development of donor-based solid-state devices in quantum computing applications within silicon. Over the years, we have established a comprehensive and robust process flow that encompasses all critical steps required for fabricating high-performance quantum devices. This process includes high-precision STM-based lithography, dopant incorporation, device encapsulation, ex situ device relocation, and advanced contact processes—each contributing to high-yield fabrication outcomes. The performance and stability of these devices are directly attributable to the precise control of materials and process conditions at the atomic scale.

One of the standard quantum device types fabricated using this technique is the single-atom transistor, which incorporates gates and nearby donor clusters to isolate electrons that serve as qubits. This presentation will focus on our efforts in the experimental realization of single-spin qubit systems, emphasizing the key challenges associated with the transmission of high-frequency signals (10-60 GHz) to the device at milli-Kelvin temperatures. Additionally, the talk will cover the design and fabrication of coplanar waveguides on the chip, as well as the development of a PCB adapter to interface with coaxial cables.