Superconducting Aluminium-Silicon Ring Devices

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The integration of superconductors within silicon devices may greatly broaden opportunities in emerging quantum technologies. Such hybrid devices are promising candidates to explore topological superconductivity and the possible existence of Majorana Fermions. Further, unique architectures to couple spin qubits to superconducting microwave resonators for qubit coupling over long distances may also be possible.

Two general approaches to render Si superconducting are non-equilibrium techniques and thermal diffusion. The former aims to incorporate an extremely high hole concentration such as via implantation/annealing [1]. In contrast, diffusion is based on metal deposition followed by a thermal process to induce silicide or alloy formation [2].

Here, we describe a Si nanowire device fabrication process formed on a silicon-on-insulator (SOI) platform [3]. During a thermal inter-diffusion anneal of deposited aluminium contact pads on silicon, AlSi is formed. The AlSi conforms to the geometry of the initial Si device. Excess Si is pushed to the top of the nano-wire, forming a thin Si ribbon. Low temperature magnetoresistance measurements on such devices are presented which exhibit fluxoid quantisation.

1. Shim and C. Tahan, Nat. Commun. **5**, 4225 (2014).
2. Ridderbos et al., Nano Lett. **20**, 122 (2020).
3. Michael Stuiber, PhD thesis, UniMelb (2019).