

2531cs1110

Atomic-Precision Acceptor Qubits in Silicon

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ProjectID	2531cs1110
Project title	Atomic-Precision Acceptor Qubits in Silicon
EPSRC theme	Quantum Technologies
Principal supervisor name	Steven Schofield
Principal supervisor UCL profile website	https://profiles.ucl.ac.uk/11379-steven-r-schofield
Host faculty and host department	Mathematical and Physical Sciences (MAPS) London Centre for Nanotechnology (LCN)
Lead department website	https://www.ucl.ac.uk/mathematical-physical-sciences/london-nano
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Standard or collaborative project	Standard project
Restrictions for candidates applying	Only Home fees candidates can apply

Project summary

Why this research is important. Boron acceptors in silicon offer a distinct route to scalable quantum technologies. The hole they bind inherits strong spin-orbit coupling from silicon's valence band, giving acceptor qubits advantages over donor qubits, including all-electrical control and readout. Realising this needs acceptors incorporated through controlled atomic-scale processes, at densities we choose, and positioned deterministically to study interactions between selected atoms. Our group recently achieved the first direct imaging of acceptor wave functions in silicon; this project builds on that capability to study substitutional boron acceptors and interactions.

Who you will be working with. You will join Professor Steven Schofield's research group at UCL, which pioneered atomically precise dopant placement. This project sits within the group's programme on donor- and acceptor-based atomic-scale device placement, including strong collaboration with the Paul Scherrer Institute (PSI), Switzerland, on STM-based fabrication with extreme ultra-violet (EUV) tools.

What you will be doing. You will aim to achieve the first atomic-precision placement of individual acceptor dopants in silicon, using hydrogen desorption lithography and controlled boron trichloride surface processes. You will encapsulate the boron dopants via molecular beam epitaxy overgrowth, and use STM to directly probe the wave functions of the buried boron acceptors. In parallel, you may explore two-dimensional layers beyond the equilibrium solubility limit, relevant for gates and contacts, providing insight into superconductivity in hole-doped silicon. You will engage with the PSI collaboration and present your work at international conferences.

Who we are looking for. We are looking for a motivated graduate in physics, chemistry, or materials science, interested in surface science, instrumentation, and quantum technology. Experience with UHV systems, scanning probe microscopy, photoelectron spectroscopy, or density functional theory calculations may be an advantage, but is not essential; full training will be provided. This is a funded studentship with supervision and publication opportunities.