PHYSICAL CHEMISTRY SEMINAR

"New Materials, Techniques, and Tools for Atomic-Scale Fabrication"

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University College London

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Advances in fundamental chemistry and physics at surfaces have opened new horizons for the atomic-scale fabrication of quantum electronic devices. Individual donor atoms can be deterministically positioned into silicon using scanning tunnelling microscope (STM) based hydrogen desorption lithography. This technique has enabled the creation of devices including one- and two-qubit gates and small-scale quantum simulators. Despite more than 20 years of remarkable progress in this field, there are not yet any demonstrations of large-scale ordered dopant arrays necessary for technological applications like a solid-state quantum computer. In this talk, I will present a brief introduction to this field and an overview of recent progress we have made at UCL in expanding the material systems, characterisation techniques, and fabrication tools for atomic-scale quantum device fabrication in semiconductors [1-4]. Our research employs ultrahigh vacuum STM, angle-resolved photoelectron spectroscopy (ARPES) and other synchrotron-based methods, and density functional theory. Notable results include fabricating and characterising the thinnest technological electron liquid in silicon (0.45 ± 0.04 nm), developing arsine as a precursor for atomic-scale fabrication on both Si(001) and Ge(001), and establishing the foundations for the extreme ultraviolet (EUV) patterning of hydrogen-terminated Si(001). I will also highlight some our other work identifying defect states in 2D materials [5,6].

Steven Schofield is a Professor of Physics at University College London (UCL), with a joint appointment between the London Centre for Nanotechnology and the Department of Physics and Astronomy. He completed his undergraduate and graduate degrees in Australia, at the University of Newcastle and the University of New South Wales, respectively. His PhD was under the supervision of Professors Robert Clark and Michelle Simmons. He has held both an Australian Postdoctoral Fellowship and an EPSRC Career Acceleration Fellowship and has lived in the UK since 2008. His principal research tools are ultrahigh vacuum scanning tunnelling microscopy and spectroscopy (STM/STS), synchrotron-based techniques like angle-resolved photoemission spectroscopy (ARPES), and density functional theory (DFT). His research interests lie in uncovering and manipulating the fundamental quantum properties of matter at the atomic scale and investigating ways to control them for applications in classical and quantum information processing.

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