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Breaking the single atom limit in atomic manipulation: Nonlocal STM induced manipulation on Si(111)-7x7

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Abstract

The tip of an scanning tunnelling microscope can manipulate individual atoms and molecules on a surface with atomic precision. Such atomic manipulation is the cutting edge of bottom-up nanoscience. Conventional atomic manipulation occurs exclusively in the tunnel junction (i.e., local to the tip) and has revolutionisednanoscience by the painstaking one-atom-at-a-time construction of bespoke nanostructures for proof-of-principle demonstrations. However, the serial one-at-a-time nature of conventional atomic manipulation makes the construction of extended structures impracticable.

Here I will report on the system of chlorobenzene on the Si(111)-7x7 surface and the STM tunnel current induced chlorobenzene desorption [1,2]. As the figure shows, charge injected from the STM tip (at 'X') induced molecular desorption of chlorobenzene molecules (dark-spots) from the Si(111)7x7 surface generating relatively clean (~10 nm radius) areas of crystal surrounding the injection site. The manipulation therefore nonlocal to the tip, occurring many nanometres distant. This mode of manipulation offers the tantalizing possibility of manipulation many molecules in parallel all with (possibly) atomic resolution.

I will conclude with some thoughts on some possible future direction for nonlocal manipulation, what it can tell us about the manipulation process, what it may reveal about nanoscale transport properties.

[1] P. A. Sloan, M. F. G. Hedouin, R. E. Palmer, M. Persson, Phys. Rev. Letts. 91, 118301, (2003).

[2] P. A. Sloan, S. Sakulsermsuk, R. E. Palmer, Phys. Rev. Letts. 105, 048301, (2010).

Biography

Peter Sloan joined the University of Bath in 2010 as a Lecturer in Experimental Physics. He was awarded a PhD in Physics from the University of Birmingham in 2004. He has worked as a Royal Society research fellow with the Nobel Prize winning chemist Prof John Polanyi at the University of Toronto, and as a Research Officer at Birmingham. His research interests lie at the boundary of physics and chemistry and explore the possibilities of controlling and manipulating individual atoms and molecules.