Electron spin and charge qubits in quantum dots

We are investigating the underlying physics of conduction through planar, ultra-dense Si:P dots defined between source – drain leads using STM lithography, where the device is patterned on one atomic plane of silicon. Initial experiments on a 70×90 nm^2 Si:P dot show a large blockaded transport region. Further dot size reduction will concentrate on making quantum dots containing only a few electrons – an important cornerstone on the way to single P atom devices, the unit cell of a Si:P Quantum Computer.

Current research focus aims at integration of a low temperature barrier which allows alignment of functional surface gates to the Si:P dots using advanced electron beam lithography.

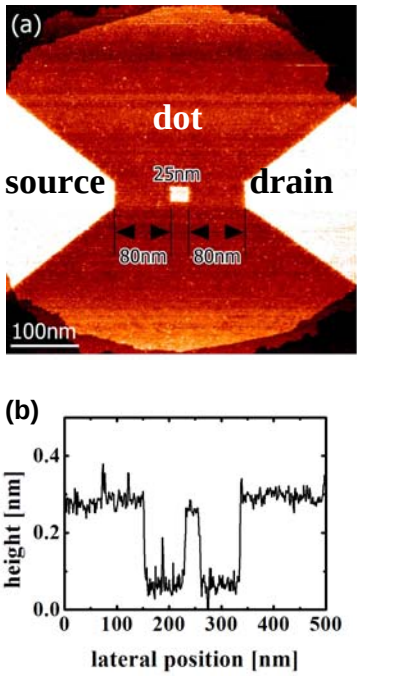

Figure 1:(a) 25 nm Si:P dot pattern between source-drain leads defined by STM lithography on one atomic plane and (b) corresponding atomic-resolution line profile.