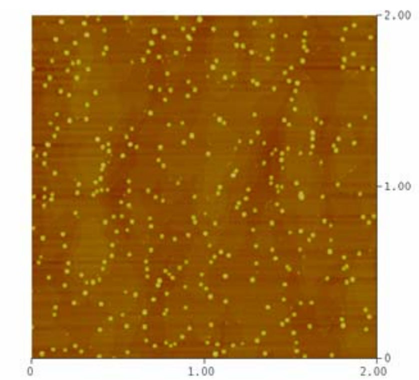
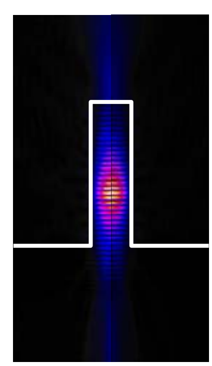
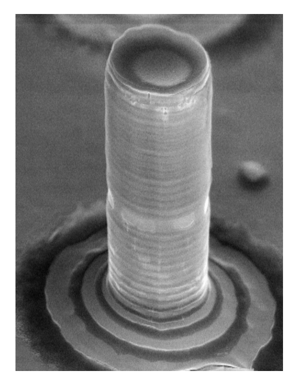
MBE growth of self-assembled InAs quantum dots on patterned substrates (PhD Project 2007)

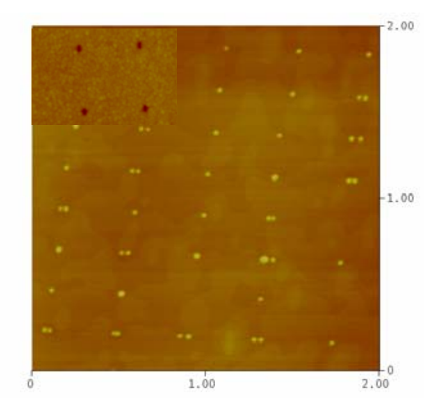


When InAs is grown on top of GaAs the lattice mismatch between the two materials results in the formation of “quantum dots” (InAs clusters of height ~8nm, diameter ~25nm) as soon as more than a critical thickness (in this case 1.6 monolayers) of InAs is deposited. The size and density of these dots is highly sensitive to the growth conditions and the amount deposited.

The 0-D density of states in quantum dots make these ideal for use as single photon emitters for use in quantum communication applications. However, this is reliant on placing only one dot in each device, such as the micro-pillar shown here, which is designed so that the light emission from a dot is coupled to the photonic mode of the pillar.







By pre-patterning the substrate with small holes which can then act as preferential nucleation sites for dot formation we have been able to place single dots in specific sites with ~ 60% success rate.

The next challenge is to achieve better control and understanding of the nucleation process, so that we can produce single dots of a specific size in each hole.

We can then investigate how the dot emission couples to a photonic mode, or can use these dots as controlled scattering centres for electrical measurements

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