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In-situ laser interference modulated MBE growth of site-controlled quantum dots

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We have demonstrated a new approaching to grow defect-free site-controlled epitaxial quantum dots (QDs) by MBE. A unique novel MBE system was designed by combining an III-V epitaxial growth capability with in-situ direct laser interference nano-patterning (LINP). Indium atoms are selectively desorbed away from the GaAs substrate at points of high light intensity generated within the in-situ laser interference patterns, encouraging selective nucleation and resulting in the highly controllable periodic formation of two dimensional defect-free QDs arrays.

Nanostructured materials are at the forefront of 21st century device innovation. The path of technological progress now takes us to dimensions of a few nanometers, at which structured materials interact at the dimensions of molecules and have electronic properties governed by quantum interactions. There is enormous potential to transform our approaches to computing, sensing, communications, diagnosis and even perhaps the treatment of disease. Yet we do not possess all the tools to develop the devices required at this challenging dimension. We need to explore innovative production methods which could overcome the limitations of conventional routes and become key enabling technologies for the second quantum revolution. Our research on site-controlled QDs is one such novel approach, which seeks to develop a transformational process for quantum-structure-arrays (QSAs). The method combines the top-down LINP with the capabilities of bottom-up structuring by self-assembly, to provide a cost-effective state of the art capability for next generation ordered QSAs. The resulting arrays will have unprecedented site and dimensional control and will be free of process defects.

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