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Tuning the growth for a selective nucleation of chains of Quantum Dots behaving as single photon emitters

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Abstract

Single and two-layer InAs/GaAs(001) samples were grown in a Molecular Beam Epitaxy chamber under critical conditions, leading to the selective growth of self-assembled InAs Quantum Dot chains over mounded GaAs surfaces. Changing the thickness of the spacer layer and the InAs deposition made it possible to tune the nucleation of 2-fold or single chains in the second layer. Finite Element Method simulations evidenced the major role of the strain field in favoring the formation of single stacked chains. On the other hand, tuning properly the As_4/In flux ratio contributed to improving the QD ordering along the chains. Microphotoluminescence experiments demonstrated single photon emission properties of the observed QDs. Our growth approach did not degrade the optical quality of the InAs QDs, allowing a significant spatial correlation between the QDs aligned along the chain.

Keywords: A1. Low dimensional structures, A3. Selective epitaxy, A3. Molecular Beam Epitaxy, B2. Semiconducting III-V materials

1. Introduction

In nanotechnology, the fabrication of sophisticated Quantum Dot devices for optoelectronics, nanophotonics or quantum computing[1, 2, 3, 4] requires the capability of producing defect-free, spatially ordered and uniformly sized Quantum Dots (QDs). Combined bottom-up and top-down methods consisting of *ex-situ* surface manipulation of the surfaces (for example electron-beam or optical lithography) are widely used and highly flexible, but often introduce defects which may deeply affect QDs' optical properties[5, 6]. The growth of

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