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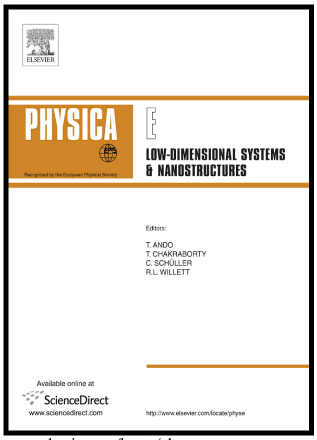

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Study of Growth Properties of InAs Islands on Patterned InP Substrates Defined by Focused Ion Beam

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ABSTRACT

This work describes morphological and crystalline properties of the InAs islands grown on templates created by focused ion beam (FIB) on indium phosphide (InP) substrates. Regular arrangements of shallow holes are created on the InP (001) surfaces, acting as preferential nucleation sites for InAs islands grown by Metal-Organic Vapor Phase Epitaxy. Ion doses ranging from 10^{15} to 10^{16} Ga^+/cm^2 were used and islands were grown for two sub-monolayer coverages. We observe the formation of clusters in the inner surfaces of the FIB produced cavities and show that for low doses templates the nanostructures are mainly coherent while templates created with large ion doses lead to the growth of incoherent islands with larger island density. The modified island growth is described by a simple model based on the surface potential and the net adatom flow to the cavities. We observe that obtained morphologies result from a competition between coarsening and coalescence mechanisms.

Keywords: growth models, nanostructures, nucleation, X-ray diffraction, arsenates, metal-organic vapor phase epitaxy

1. INTRODUCTION

Quantum dots (QDs) are atom-like carrier-confining nanostructures that can be used in high efficiency LEDs, lasers and photodetectors, among other applications. The role of QDs in the efficiency gain of such devices comes from the three-dimensional confinement of the charge carriers resulting in a discrete distribution of their energy levels. Tuning shape, size, density, size distribution and composition of the QDs allow the design of devices for very specific applications [1,2]. However, to achieve this possibility a fine control of deposition/growth variables is mandatory. Despite of the capabilities of the usual growth techniques, which provide a good control of the composition, the adsorption of precursors on multifaceted or rough surfaces may occur as a sum of distinct surface-mediated mechanisms, rendering the process uncontrollable. Growing in such