

LATERAL ORDERING IN InAs/GaAs STACKS GROWN ON InP/InGaP ARRAYS

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Self-assembly of InAs/GaAs has been extensively investigated by the scientific community. Both theoretical and experimental works have shown that vertical ordering of quantum dots may lead - via their elastic strain fields - not only to a better size homogeneity but also to a better lateral arrangement. However, despite the lateral ordering tendency, an increase of the island size has been found in III-V dot superlattices. Moreover, the lateral ordering degree achieved in these systems has been rather limited. Alternative approaches such as patterned surfaces, vicinal substrates and misfit dislocations networks were proposed in order to solve this problem.

We have obtained bidimensional arrays of InP quantum dots grown on slightly In-rich (0.6% mismatched) InGaP/(001)GaAs layers by chemical beam epitaxy. The InP periodic array is aligned along both [110] and [-110] directions, due to a periodic strain field created by compositional modulation, which induces preferential InP nucleation. In this work, we use this two-dimensional matrix of InP islands as a template for the lateral ordering of InAs dots in InAs/GaAs bilayers. An uncapped layer of InAs dots was deposited on the top surface of all samples in order to study the lateral ordering by atomic force microscopy (AFM). Fast Fourier transform (FFT) of the AFM images was used to quantify the dot lateral ordering degree. The correlation between the ordering of the first InAs dot layer and the InP template was investigated by cross-section transmission electron microscopy (XTEM) measurements. The results presented here show a path for obtaining highly ordered three-dimensional arrays of InAs dots, which could be widely used in new generation quantum devices.

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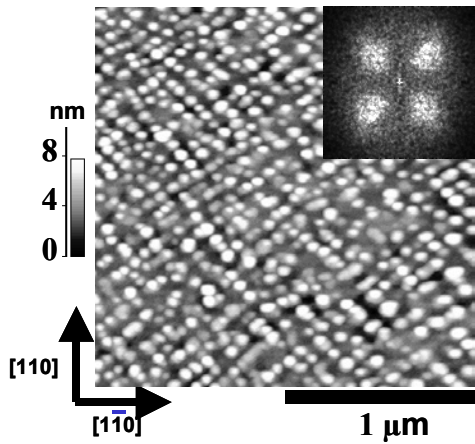


Fig.1 - AFM image showing InP dots grown on a InGaP/GaAs buffer layer presenting compositional modulation. The inset shows the FFT of the image.

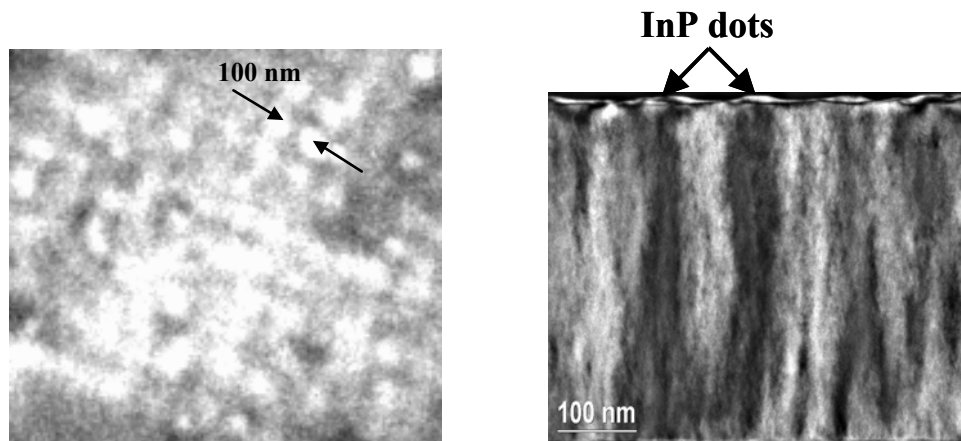


Fig.2 - Plan view TEM (left) of the InGaP layer with compositional modulation and (right) cross section TEM showing the dark/bright contrast associated to this modulation and the InP dots on top of In-rich regions of the surface.

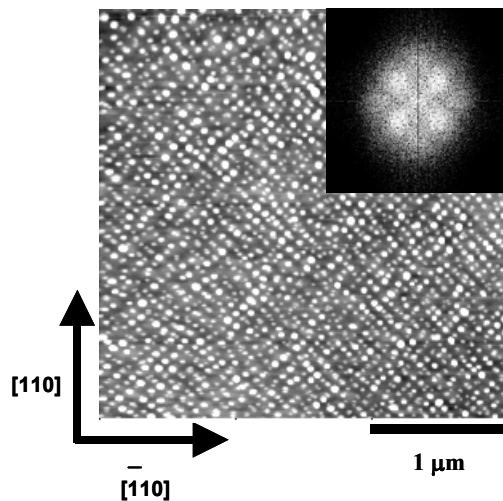


Fig.3 - AFM image showing the top surface of the InAs/GaAs/InP/InGaP structure. The inset shows the FFT of the image; the characteristics are similar to those in Fig.1.