

# Directed growth of self-assembled InAs quantum dots on shallow GaAs [-110] nanostripes thanks to an intermediate strained GaInAs layer

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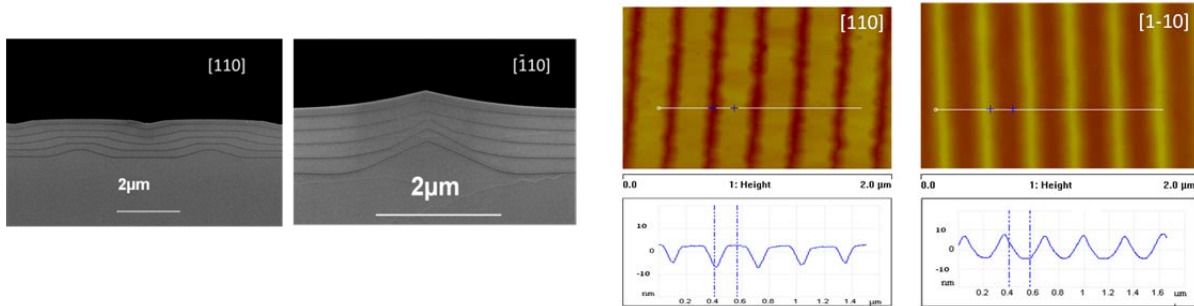
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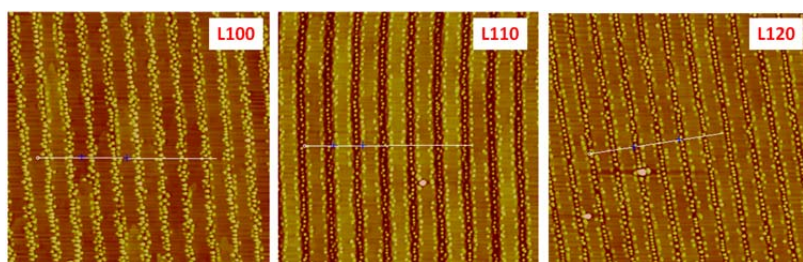
Self assembled quantum dots were grown on GaInAs strained buffer by molecular beam epitaxy on pre-patterned GaAs surfaces[1]. The patterns formed by e-beam lithography in PMMA consist in nanogroove arrays oriented along the  $\langle 110 \rangle$  directions of the underlying (001) GaAs surface of a buffer layer. Transfer of the patterns into GaAs was carried out by chemical etching, leading to shallow nanogrooves, with low angle slope facets. These patterned surfaces were deoxidized prior to epitaxy, thanks to H-plasma [2] at low temperature ( $<500^\circ\text{C}$ ) which prevents the surface from nanopits.

Growth of GaAs on the patterns oriented along the two perpendicular  $\langle 110 \rangle$  directions leads to different features orientations. We have used the [-110] direction for quantum dots growth. No positioning could be obtained directly on GaAs as achieved in literature [1,3]. We will show how the [1-10] oriented grooves evolve after growth of these nanostructures and how the quantum dots positioning can be controlled by inserting a GaInAs layer with appropriate geometry.



GaAs with AlAs markers on microscopic patterns (MEB) along [110] and [-110]

15nm-thick GaAs grown on nanopatterns (depth: 20nm-period: 300nm) (AFM)



Regrowth of InAs quantum dots with GaInAs strained buffer on nanopatterned GaAs along [-110] (AFM image:  $3\mu\text{m} \times 3\mu\text{m}$ ) with different etched widths (L). (depth: 20nm - stripe period:  $250\mu\text{m}$ )

[1] H. Lee, J. A. Johnson, M. Y. He, J. S. Speck, et P. M. Petroff, « Strain-engineered self-assembled semiconductor quantum dot lattices », *Appl. Phys. Lett.*, vol. 78, n° 1, p. 105-107, 2001.

[2] S. Ritchie, S. R. Johnson, C. Lavoie, J. A. Mackenzie, T. Tiedje, et R. Streater, « Semiconductor substrate cleaning and surface morphology in molecular beam epitaxy », *Surf. Sci.*, vol. 374, n° 1-3, p. 418-426, mars 1997.

[3] S. Kiravittaya, A. Rastelli, et O. G. Schmidt, « Self-assembled InAs quantum dots on patterned GaAs(001) substrates: Formation and shape evolution », *Appl. Phys. Lett.*, vol. 87, n° 24, p. 243112-243112-3, 2005.