

Electron Beam Exposure to localise Silicon Nano-Crystals Nucleation

L.MOLLARD¹, F.MAZEN¹, T.BARON² and J.M. HARTMANN¹

¹C.E.A, 17 avenue des martyrs, 38054 GRENOBLE Cedex9 France

²LTM, CNRS, 17 avenue des martyrs, 38054 GRENOBLE Cedex9 France

Synthesis of silicon nano-crystals (Si-Ncs) has been intensively studied in the last two years because of its potential applications for future electronic devices. Several techniques enable the production of silicon nano-structures, however a precise location of the Si-Ncs has not been achieved up yet.

Si-Ncs nucleation is strongly influenced by the substrate surface chemistry [1], and a self-organisation on a substrate, which contains a regular array of dislocations, has ever been obtained [2].

In this way, we have demonstrated that direct Electron Beam exposure - 100 KeV - on insulator material (like SiO₂, SiH₄...) create preferential nucleation sites for Si-Ncs grown. Actually, after deposition via SiH₄ Chemical Vapor Deposition, a control of the Si-Ncs in the growth plane could be obtained –figure 1. As shown, Si-Ncs nucleates preferentially on exposure area with a selectivity close to 14 between exposed/no exposed areas – figure 2.

This nucleation selectivity depends both on the Si-Ncs spatial location and on the exposure parameters (like spot size) - figure3.

These results open new paths for the realisation of single-electron components like single electron transistor (SET) and single electron memories (SEM).

References:

[1] S.Myazaki and al., Thin Solid Films, 369, 55 (2000)

[2] T.Baron and al., JECS 150, 2003, G203.

Figure 1 : AFM images of Si-Ncs deposited on modified SiO₂

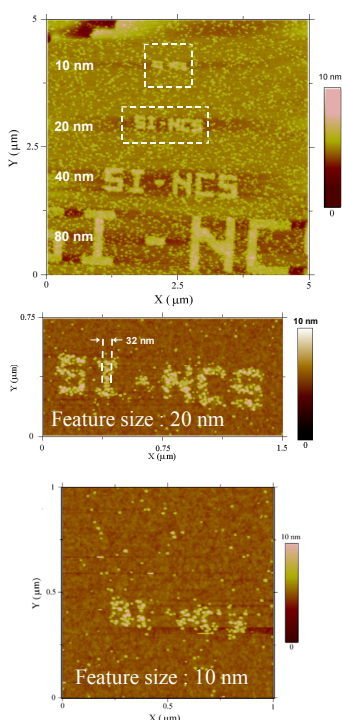


Figure 2 : selectivity vs dose

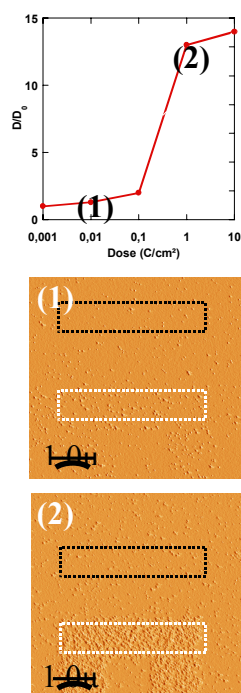


Figure 3 : eBeam simulation
Radial energy distribution versus standard deviation of spot size (σ_{ss})

