Properties of Ge/Si nanostructures: alloying, stability and positioning

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Exploiting growth processes and kinetic instabilities to form surface nanostructures and patterns is emerging as a key element in strategies for nanoscale fabrication. In heteroepitaxy, the strain energy caused by the lattice mismatch competes with kinetics to form nanostructured films [1, 2]. Ge on Si is a model heteroepitaxial system that follows the Stranski–Krastanov growth mode, and is widely investigated for prospective applications in nanoelectronics and optoelectronics. By combining Scanning Tunneling Microscopy, Low Energy Electron Microscopy and X–Ray Photoemission Electron Microscopy (XPEEM) we investigate the growth of Ge/Si Quantum Dots (QDs) on Si(111). Critical issues include:

(1) Ge–Si intermixing [3–6] that occurs during growth, which alters the composition of the as grown QDs. This problem has been widely investigated using synchrotron radiation techniques such as X–Ray Absorption Fine Structure [3] and XPEEM [4, 5]. Recent developments allowed us to ***map the chemical concentration of individual*** Ge(Si) nanostructures [6].

(2) The control of QD positioning [7] on patterned substrates,

(3) Nanostructure stability with respect to annealing [8].

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