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Stress and Composition of SiGe Nanostractures on Curved Substrates

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Abstract: Experimental studies [1] of Ge nanoislands grown on Silicon-on-Insulator (SOI) substrates have shown that the strain distribution in such heterostructures is very different from that observed during Ge growth on thick Si substrates. This is accompanied by a defect-free strain relaxation mechanism through the bending of the substrate induced by the nanoisland. However, it is totally unknown how local bending affects the island composition and its distribution, something crucial to understand for device applications. Here, we present our recent work [2] aiming at clarifying this issue. Using atomistic Monte Carlo simulations and analytical modeling [3], we couple this bending relaxation mechanism with interdiffusion and alloying. We observe composition profiles that are completely different from those observed in flat nanoislands (Fig. 1, a). Moreover, for comparable SOI and island thicknesses, intermixing can be greatly reduced and Ge content in the islands is highly preserved (Fig. 1, b).

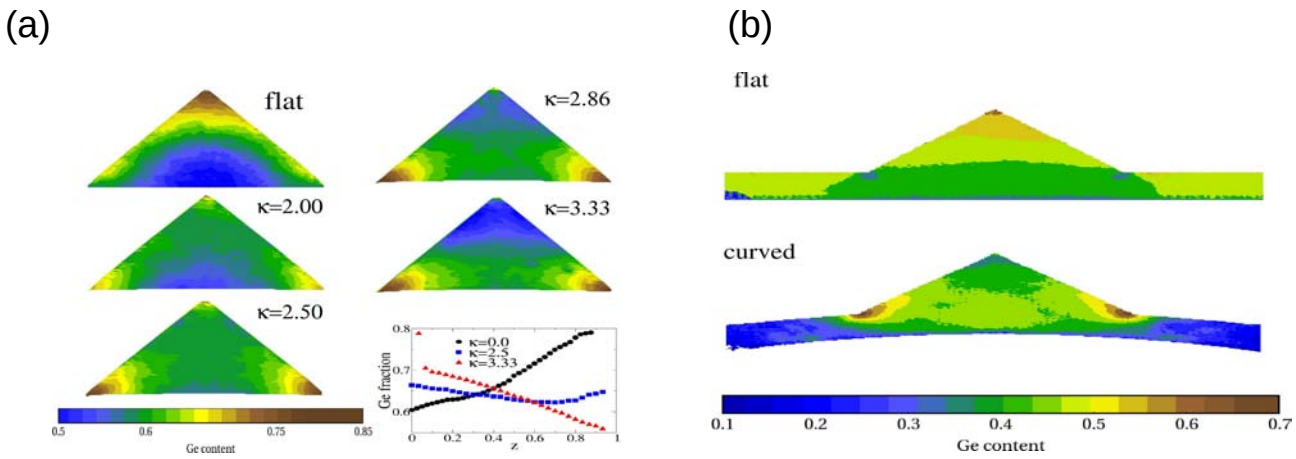

Figure 1: (a) The equilibrium composition profile at 900 K of a Ge-rich (65% Ge) {111} pyramid for both flat and curved geometries. The units of the curvature κ are 10−3 nm −1 . The graph shows the Ge fraction, averaged laterally, along the growth direction (in relative units). (b)The Ge composition profile of a SiGe pyramid on SOI for flat and curved ($\kappa = -5 \times 10^{-3}$ nm $^{-1}$) substrates.

References:

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