Strained Induced Stabilization of Stepped Si and Ge Surfaces

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Abstract

The growth of strained $Si_{1-x}Ge_x$ alloy islands on Si(001) reveals that pyramidal quantum dots with (105) facets ("huts") are formed for a certain range of temperatures and Ge coverage . Further growth of the pyramids results in more complicated "dome" shapes, bounded by high index facets, such as (113). There are two fundamental issues we'll address in this talk.

First, the experiments show that there is no nucleation barrier for the growth of the pyramids. Second, we determine the surface reconstruction of the (105) facets and show how it influences the growth dynamics. We report on calculations of the formation energies of several [100] and [110] oriented step structures on biaxially stressed Si and Ge (001) surfaces. We find that a novel rebonded [100] oriented step is strongly stabilized by compressive strain compared to most well-known step structures. We propose that the side walls of the "hut"-shaped quantum dots observed in recent experiments on SiGe/Si films are made up of these steps.

Our calculations provide an explanation for the nucleationless growth of shallow mounds, with steps along the [100] and [110] directions in low-and high-misfit films, respectively, and for the stability of the (105) facets under compressive strain.

Guest Speaker:

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Tuesday, November 5, 2002
Room W183 Nebraska Hall
3:30 p.m.

Host: Professor Florin Bobaru, Department of Engineering Mechanics
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A reception with refreshments sponsored by the Engineering Mechanics Department will be held at 3:00 p.m. in the Engineering Mechanics Department Conference Room (W317.1 Nebraska Hall).

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