Size and Geometry Dependence of Surface Strain fields in Systems of Buried Quantum Dots*

Jianxin Zhong[1], Jack C. Wells[1], Qian Niu[2], and Zhenyu Zhang[3]

[1] Center for Engineering Science Advanced Research and
Computer Science and Mathematics Division, Oak Ridge National Laboratory

[2]Department of Physics, University of Texas at Austin, Austin, Texas 78712
[3]Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831

Abstract

Strain distributions induced by buried islands of finite sizes with pyramidal shape are examined using classical continuum theory. We show that, upon increasing the spacer layer thickness, the decay of the strain field on the spacer layer surface exhibits a crossover behavior from lower power laws to a higher (inverse cubic) power law. The exponent for the lower power-law decay in the smaller separation regime depends on the base-height ratio of the island with smaller exponent corresponding to smaller value of this ratio. Additionally, the strain is approximately proportional to the island volume when the ratio is larger, but is approximately proportional to the island area when the ratio is small. Based on our findings, a discrepancy derived from two large-scale molecular dynamics simulations, namely, whether the strain distribution of a pyramidal Ge/Si island can or cannot be modeled by a point inclusion, can be well understood by noticing the geometry difference of the islands in those simulations [1,2]. The finite size effect of the strain distribution on the self-organization of quantum dots will also be discussed.

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[2] I. Daruka, et al, Phys. Rev. B 60, R2150 (1999).

* Research partially sponsored by the Engineering Research Program of the Office of Basic Energy Sciences, U. S. Department of Energy. The Oak Ride National Laboratory is managed for the U. S. DOE by UT-Battelle, LLC, under contract No. DE-AC05-00OR22725.