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Growth of Semiconductor Quantum-Dot Molecules in Heteroepitaxy*

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Abstract

We show that the surface strain distributions induced by embedded islands of different geometry provide a unique way for fabrication of coherent quantum-dot molecules with many potential applications. We demonstrate the approach by analyzing the Ge/Si growth system and show that the surface strain on a Si spacer-layer surface induced by an embedded square-shaped Ge island of large base-to-height aspect ratio deviates significantly from the description of the point force dipole model in the regime of small spacer-layer thickness. In this regime, the strain profile displays four symmetrically distributed local maxima directly above the embedded island due to the finite size effect of the embedded island on strain distribution. Under appropriate growth conditions, the regions with local strain maxima serve as nucleation centers for growth of surface Ge islands, resulting in a quantum-dot molecule consisting of four Ge islands of four-fold symmetry. Our theoretical results [1] are supported by several recent experimental observations [2].

[1] J.J. Zhang, K.W. Zhang, and J.X. Zhong, Appl. Phys. Lett. **84**, March, (2004); Surface Science **551**, L40-L46, (2004).

[2] G. Capellini, M. De Seta, C. Spinella, and F. Evangelisti, Appl. Phys. Lett. **82**, 1772 (2003).

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