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Direct Measurements of Strain Depth Profile Changes in Ge Nano-structures on Si (001) with Pyramid to Dome Shape Transition

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Strain depth profiles in Ge layers of varying surface morphology grown on Si(001) by gas-source molecular beam epitaxy are directly measured by medium energy ion scattering spectroscopy. Films consisting solely of pyramidal Ge nano-structures exhibit a uniform strain profile with a compressive strain of 2.1 %. Ge layers with a dome-dominated surface morphology exhibit significant surface strain relaxation corresponding to a strain of 0.6 % while the compressive strain at the Ge/Si(001) interface remains unchanged. The strain gradient observed within dome structures suggests that surface strain relaxation plays an important role in the Ge pyramid to dome shape transition.