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Effects of Nanostructure Formation in InAs/GaSb Superlattices

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Self-organized semiconductor nanoscale structures (wells, wires and dots), based on the morphological instability of strained molecular beam epitaxial grown films, has been observed in many III-V systems and is of great importance from both a fundamental and technological point of view. In the non-common anion InAs/GaSb (001) superlattices, which has a small strain, unstable growth at a thickness of a few monolayers has been observed to form nanowire structures. In this talk, the results of a structural and optical analysis of nanostructure formation in these superlattices grown with different interfacial bonds will be presented. X-ray diffraction and kinematical modeling showed that the type of interfacial bond and the sign and magnitude of the strain in the superlattice layer are crucial for the spontaneous formation of the nanowires; therefore, with proper design of the interface, self-assembled nanostructures can be grown in material systems with small strain, which would otherwise be impossible. Optical absorption response of nanowire samples were compared to that of planar samples. The optical data suggests that by manipulating the strain state of the superlattices using various interface and buffer layer material, the optical response of the system may be controlled. Control of the nanostructure formation and the properties of the superlattices may lead to improvement in current or the development of new optoelectronic devices.