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Strained layer superlattices for dislocation reduction in III-V on V-groove patterned (001) silicon

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We investigate the effects of $In_xGa_{1-x}As$-based strained layer superlattices (SLSs) on dislocation filtering for high quality GaAs and InP epitaxially grown on V-groove patterened on-axis (001) Si substrates. With the systematically optimized SLSs, a defect density of 9.1×10^6 cm^{-2} was demonstrated using large-area electron channeling contrast imaging (ECCI) for characterization. The interaction between the strain field of the SLSs with threading dislocations (TDs) is evaluated by scanning transmission electron microscopy (STEM). Meanwhile, the InGaAs/InP SLSs were utilized to reduce the surface dislocation density for a larger lattice mismatched InP on V-grooved Si (IoVS) with GaAs as an intermediate buffer. A defect density 1.82×10^8 cm^{-2} was demonstrated, which is a factor of three lower than the same thickness IoVS template without any SLS insertion.

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