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A Process and Structure for Growing Compound Semiconductors on Silicon

M. F. Chisholm O. W. Holland, and J. D. Budai

Solid State Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831

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A Process and Structure for Growing Compound Semiconductors on Silicon

M. F. CHISHOLM, O. W. HOLLAND and J. D. BUDAI, *Oak Ridge National Laboratory, Oak Ridge, TN 37831.*

The ability to from a wide variety of heterostructures on Si is critical for enhancing the functionality of integrated circuits. The Holy Grail of optoelectronics is to integrate GaAs and Si on a single platform to provide both optical and digital functionality. One widely attempted approach is to use an intermediate epitaxial layer on Si that more closely matches the lattice of the GaAs film. Ge with a lattice constant nearly identical to that of GaAs has been investigated as an intermediate layer with little success because of the large number of threading dislocations formed when depositing Ge vapor on Si. We have revisited this approach and show that epitaxial Ge-containing films on Si produced by implantation and oxidation have very much lower defect densities. These films form on Si during the thermal oxidation of Ge^{+}-ion implanted Si. Ge is completely rejected at the growing oxide interface where it accumulates forming a distinct Ge-containing layer. This growth technique constrains the film to develop as a 2D layer instead of the normally observed 3D islands. Characterization of the films (X-ray, RBS and Z-contrast imaging) demonstrate that processing conditions can be adjusted to vary the composition and lattice parameter of the layer from Ge to Si. This provides the possibility of template layers lattice matched to a number of III-V and II-VI compound semiconductors.

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