The Study of Heterostructure Growth of SiGe, GaAs and ZnSe on Si Substrate

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ABSTRACT

An interface-blocking mechanism was proposed to reduce the threading dislocations in the SiGe and Ge layers grown on the Si (100) substrates. In this study, epitaxial $Si_{1-x}Ge_x$/ $Si_{1-(x-y)}Ge_{x-y}$ and Ge/ Si_yGe_{1-y} layers were grown by UHV/CVD. It was found surprisingly that if the Ge composition, y, was varied across the interface of $Si_{1-x}Ge_x$/ $Si_{1-(x-y)}Ge_{x-y}$ or Ge/ Si_yGe_{1-y} above a certain value, most of the threading dislocations appear to be blocked and confined in the underlying $Si_{1-(x-y)}Ge_{x-y}$ or Si_yGe_{1-y} layer by the interface. This finding provides a simple way to grow high-quality relaxed SiGe and Ge layers on the Si substrates. The growth of high-quality epitaxial Ge layers on a Si (100) substrate was demonstrated by using this method. Experimental results showed that the dislocation density in the top Ge layer was greatly reduced, and the surface was very smooth, while the total thickness of the structure was only 2.6μm. It implies that this finding can provide a virtual substrate for growing GaAs and ZnSe on Si. The growth of the high-quality GaAs and ZnSe layers on the Ge/Ge_xSi_{1-x}/Si virtual substrates is demonstrated in this work with the dislocation density of GaAs and ZnSe about 3×10^{-6} cm^{-2} and the epitaxial layers also show a excellent optical characteristics. The total thickness of the GaAs/Si and ZnSe/Si was only 5.1μm.