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Stacking fault density and local interface composition in II-VI/III-V heterostructures

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Abstract

ZnSe/GaAs(100) heterostructures are crucial elements of most demonstrated blue-green lasers. The limited lifetime observed for such devices has been associated with stacking faults at the ZnSe/GaAs interface. Such defects would act as sources of dislocations and dark-line defects during laser operation. We fabricated by molecular beam epitaxy (MBE) pseudomorphic ZnSe/GaAs(001) as well as lattice-matched ZnSe/$In_{0.04}Ga_{0.96}As$(001) heterostructures and determined the dependence of the stacking fault density on the interface composition by transmission electron microscopy. For both strained and unstrained heterostructures we found that the Zn/Se flux ratios employed during the early growth stage, and the resulting interface composition controls the native stacking fault density in the layers. In particular, the density of Shockley stacking fault pairs decreases by three to four orders of magnitudes in going from Zn-rich to Se-rich interfaces. The density of Franck stacking faults is also affected, although to a lesser extent. Minimum areal densities of both types of stacking faults in selected samples with Se-rich interfaces were below our experimental sensitivity.