MBE growth of High Quality GaAs on C-plane Sapphire Substrate

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Heteroepitaxy of III-V semiconductor is a well-established field. Generally, the term heteroepitaxy is used to denote the growth of dissimilar materials having similar crystal structure but different lattice constant. Very few examples exist in literature regarding single-crystal epitaxy of two semiconductors with dissimilar crystal structures such as cubic on wurtzite or cubic on trigonal. There have been a few works regarding cubic SiGe growth on a trigonal sapphire substrate. In this report, we discuss the growth of quality GaAs buffer on c-plane sapphire. Our motivation to grow GaAs on sapphire is based on its potential use in III-V microwave photonics, optoelectronics and electronics owing to the properties, such as, a large contrast in refractive index between GaAs and sapphire, the high resistivity of sapphire substrate and the transparency of the sapphire substrate near the III-As band gap.

When grown on c-plane sapphire, GaAs tend to grow along the [111] orientation. In our experiments we have observed that the growth of GaAs on sapphire has a small range of parameter for best quality material. In this window, our samples show a surface RMS roughness as low as 1.6 nm; a rocking curve linewidth comparable to the GaAs substrate at 90 arcsec, good photoluminescence efficiency, and suppression of twinning in GaAs to less 0.1%. The latter was accomplished by utilizing different growth strategies, such as, a low temperature initial layer, multiple annealing cycles and by optimizing growth parameters (growth temperature and arsenic flux).

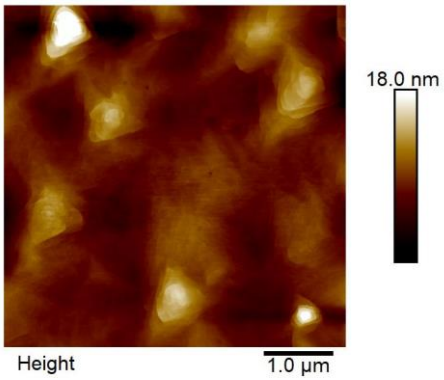

Figure 1 AFM image of GaAs/Sapphire.

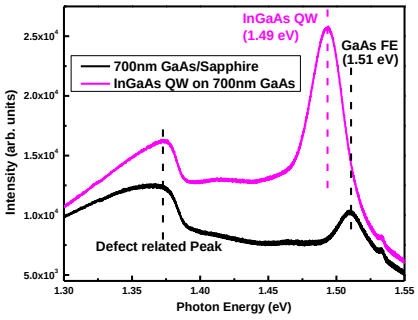

Figure 2 PL from GaAs buffer and InGaAs quantum well samples. GaAs FE denotes the free-exciton peak.

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