Metamorphic heterostructures with InAlAs/InGaAs/InAlAs quantum well on GaAs substrates have slightly inferior structural quality – surface morphology and structural defects density as compared to InP-based HEMT. The heterostructures were grown on (1 0 0) oriented and (1 0 0) + 2° vicinal GaAs substrates. The structural perfection of a composite quantum well was investigated (fig.1, 2) by aberration corrected (probe Cs corrected) TEM/STEM TITAN 80-300. The structural parameters of the layers and the interfaces including flatness were studied by high-resolution HAADF STEM. By using the intensity histogram filtration, it was found, that the interfaces between the bottom part of the In enriched layers and the top part of metamorphic buffer (MB) layers were flat and abrupt. The dislocation density was estimated by weak beam dark field imaging method. The dislocations of different types were observed and some of them were associated with stacking faults. The estimated dislocation density in the MB was 5x10^9 cm^-2. In all samples these dislocations were uniformly distributed over the whole MB and close to the inverse layer their density decreases to 5x10^8 cm^-2. After the inverse step and smoothing layer, and close to the active region of the heterostructure the dislocation density decreased further by two orders of magnitude. The heterostructures with nano-inserts of InAs in the quantum well on InP substrates will be considered in this work (fig.3). It was found, that the influence of the quality of the quantum well heterointerfaces on the electron mobility is not the dominant factor.

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Fig. 1: HR HAADF STEM images of the QW area of the (a) "(100)" sample and (b) "(100) + 2°" sample

Fig. 2: The histograms of HR HAADF STEM signal intensity of the QW area and the corresponding interpolating functions

Fig. 3: STEM image of QW and corresponding intensity histogram