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Measurement of the surface potential of AlGaAs/GaAs heterostructures using Kelvin Probe Force Microscopy

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Abstract content
   (Max 300 words)
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In this study, cross-sectional potential imaging of AlGaAs/GaAs heterostructures is investigated. The measurements were performed using Amplitude Modulation Kelvin Probe Force Microscopy (AM-KPFM) in air at room temperature. The AM-KPFM measurement technique is usually carried out in two main stages: In the first stage, the sample topography is obtained using standard tapping mode atomic force microscopy (TM-AFM). In the second stage, the cantilever stays at a constant height and an external voltage in the form V_DC+ V_AC sin(w_AC t) is applied between the tip and sample (with a pre-set step size) to measure the Contact Potential Difference (CPD). It is shown that GaAs quantum wells with a few nanometer thickness, embedded in an AlGaAs matrix, can be detected using TM-AFM method. However, a flat surface potential (zero CPD) has been obtained. This result, which still needs to be optimized, can for the moment be explained by the rather low mole fraction of AlAs (0.35 in our case) contained in the AlGaAs matrix. In fact, it has been reported that the CPD between GaAs and AlGaAs increases monotonically with increasing AlAs fraction mole. CPD values around 120-180 meV have been reported for an AlAs mole fraction of 0.8, while the CPD for an AlAs mole fraction of 0.3 was almost zero. Further details of the morphology and electrical properties of cross-sections of a variety of AlGaAs/GaAs heterostructures will be presented.

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