Epitaxy and Characterization of superconducting Aluminum Films on InAs Quantum Well Heterostructures

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The epitaxial coupling of superconductors and high spin-orbit coupled semiconductors has recently been of growing interest for topological quantum computation applications [1]. Reducing disorder at the superconductor-semiconductor interface and in the superconducting layer is of main importance to improve device performance [2]. In this study, we focus on the in-situ molecular beam epitaxial deposition of Al superconducting layers on top of high spin-orbit coupled InAs planar heterostructures [3, 4].

The structural properties of the Al epitaxial layer will be reported relying on transmission electron microscopy (TEM). The determination of the predominant Al growth orientation, of the presence of grains and their properties and the characterization of the defects present in the Al layer are important parameters that we will present.

Figure 1 reports high resolution TEM data associated to Al-InAs hybrid planar hetero-structures with different strain profile in the quantum well. A clear impact of the strain on the Al growth orientation is observable in Figure 1(b) with the transition of the Al growth orientation from (111) to (110). The impact of Al growth temperature will also be analyzed.

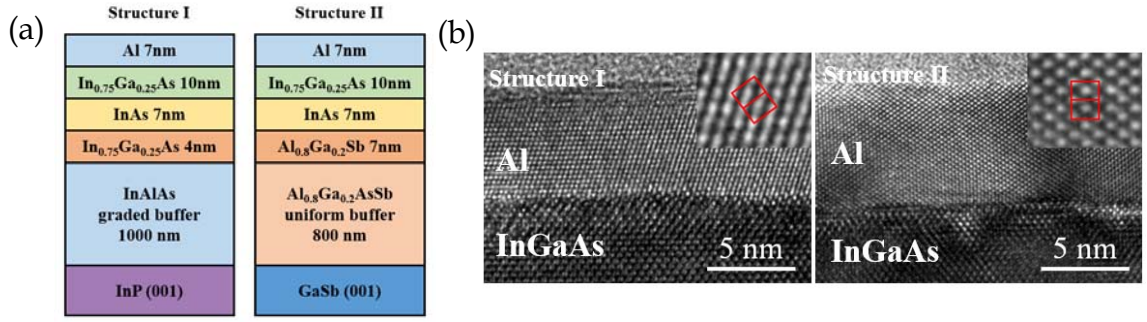

Figure 1. The layer stack of two types of Al-InAs quantum well heterostructures (a) and the high-resolution TEM images of the aluminum layer in the two structures (b). The red lines represent one Al unit cell, indicating that the growth orientation is (111) for structure I and (110) for structure II. The zone axis is along InGaAs[$1\bar{1}0$].

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