Growth and Characterization of $Al_{0.48}In_{0.52}As$ on InP (100) by hybrid MBE-CBE for optoelectronics applications

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$Al_{0.48}In_{0.52}As$ ternary alloy lattice matched to InP is of great interest for optoelectronics devices [1]. In fact, AlInAs alloys are very desired for new generation avalanche photodiode (APD) due to their large band gap, high ionization ratio and low excess noise [1]. However, high quality growth of these alloys either by MBE, MOCVD or CBE is quite difficult due to clustering, lattice matching control and impurities (O and C) contamination [2], [3].

In this work, we demonstrate the epitaxial growth of high quality, low strain and low background doping of $Al_{0.48}In_{0.52}As$ at 500°C on Fe-doped semi-insulating InP(100) substrate by using hybrid MBE-CBE technique. The precursors that were used are: solid aluminum, solid indium, TriMethylIndium (TMIn) and thermally cracked arsine. Using Nomarski, we observed smooth surfaces for the as grown layers. High-Resolution X-ray Diffraction (HR-XRD) in the vicinity of the (004) reflexion shows a lattice mismatch in the range -137 to 127ppm (figure 1.a). The carrier density of undoped layers, obtained by Hall measurement at room temperature, is as low as 3E+15 cm^{-3} which is three orders of magnitude lower than the identical layers grown by organometallics sources (figure 1.b). Photoluminescence (PL) for $Al_{0.48}In_{0.52}As$ at low temperature (LT) shows a good optical quality (figure 1.c). The quality and purity of the alloys grown here are compatible with high performance APD for optical communication.

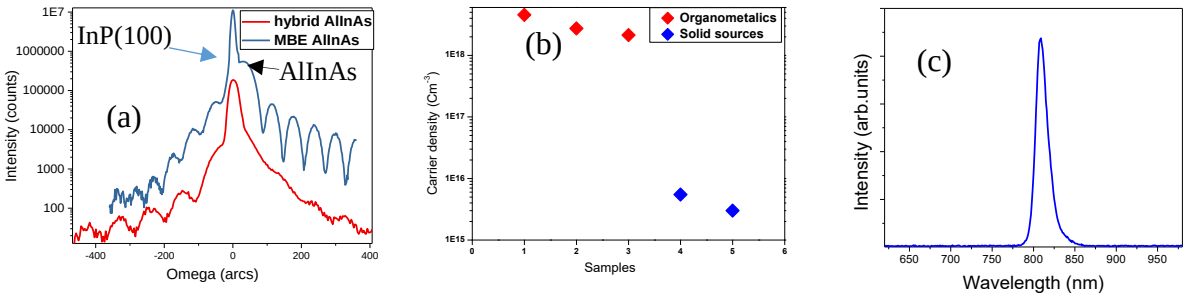

Figure 1: (a) HR-XRD curves of $Al_{0.48}In_{0.52}As$ layers grown by hybrid-CBE and MBE. (b) Background comparison between $Al_{0.48}In_{0.52}As$ layers as grown by organometallics and solid sources respectively. (c) LT PL spectrum from $Al_{0.48}In_{0.52}As$ layer grown by solid sources.

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