Growth and Characterization of undoped InGaAs by hybrid MBE-CBE for optoelectronic applications

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InGaAs is one of the most commonly used active layer in III-V based optoelectronic devices [1], thanks to its distinctive properties such as high electron mobility, peak velocity and direct band gap [2], [3]. So far, this alloy is grown by standard technics such as MBE, MOCVD or CBE. However, there are several challenges to overcome in order to obtain pure and cost effective InGaAs epitaxial layers.

In this work, we will discuss the use of a custom MBE-CBE reactor which combines solid and vapour sources to grow high quality InGaAs layers. This alloy has been grown on semi insulating InP substrate (001) using an indium K-cell, triethilgallium (TEGa) as group III precursors and arsine (AsH3) as group V at 500°C. Fig. 1(a) shows an in-situ reflection high energy diffraction (RHEED) pattern of InGaAs where streaky lines are observed demonstrating a layer-by-layer growth mode. Illustrated in Fig. 1(b), the high resolution X-ray diffraction (HR-XRD) measurements along the (004) direction was carried out on $In_{0.53}Ga_{0.47}As$ epilayers and gives a lattice mismatch of 9E-03. Furthermore, Hall effect measurements performed on undoped InGaAs layers are plotted in Fig. 1(c). They show carrier densities around 1E+15 cm^{-3}, which are roughly two orders of magnitude lower than samples grown by standard CBE. These preliminary results are promising toward achieving the growth of photodetector heterostructures, such as avalanche photodiode, which requires pure active layers.

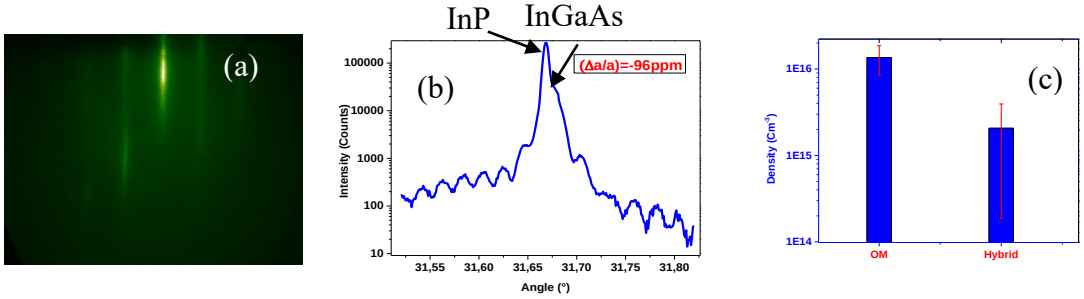

Fig. 1: (a) and (b) RHEED patterns of and HRXRD for InGaAs grown by Hybrid MBE-CBE respectively. (c)Background density of undoped InGaAs grown by standard CBE and hybrid.MBE-CBE.

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