Optical And Structural Properties Of GaInAsBi/GaAs MQWs

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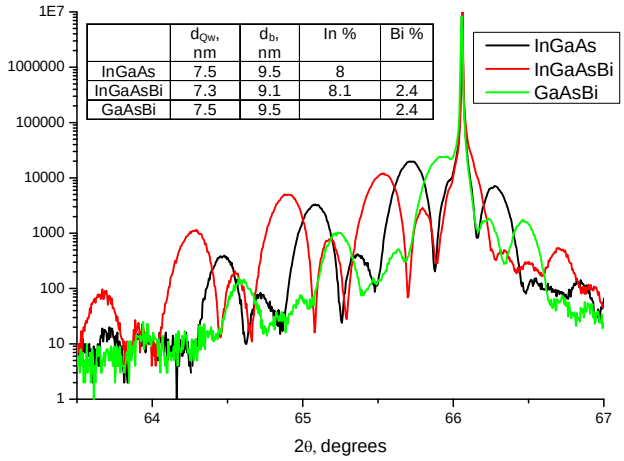
III-V group compounds attract scientists because of their wide use in optoelectronic devices. GaInAs layers for quite a long time are used for diodes and photodetectors in the near infrared spectral range. Incorporation of bismuth into this alloy has several advantages such as weaker energy bandgap temperature dependence and fast reduction of the bandgap even with small percentage of Bi. The aim of this work was to grow and investigate GaInAsBi multiple quantum wells (MQWs).

GaInAsBi/GaAs MQWs were grown by molecular beam epitaxy (MBE) on GaAs (100) substrates. The substrate temperature was varied in the range of 240–300 ^{o}C. QW thicknesses were ~7.5 nm and the barriers were ~9.5 nm thick. MQWs were characterized by high resolution X-ray diffraction (HR-XRD) and photoluminescence (PL). The strongest PL signals and, according to the HR-XRD results, the best crystalline structure was achieved for MQWs grown at 270 ^{o}C. To investigate the indium influence on bismuth incorporation and to determine exact In and Bi concentrations GaInAs/GaAs and GaAsBi/GaAs MQWs were grown additionally. Growth temperatures were kept the same as for GaInAsBi/GaAs MQWs. Bismuth and indium fluxes were fixed in order to calculate the composition of quaternary GaInAsBi quantum well. HR-XRD rocking curves (Fig. 1) showed that indium does not have significant influence for incorporation of bismuth into GaInAs. HR-XRD results measured on different experimental structures correlate with the PL data.

GaInAsBi/GaAs MQWs with different bismuth content were grown. From XRD results these layers compositions are ~8% of In and 0,9–4,2 % bismuth. The higher bismuth concentration shifts PL peak to smaller peak energies.



	d_{QW}, nm	d_b, nm	In %	Bi %
InGaAs	7.5	9.5	8	
InGaAsBi	7.3	9.1	8.1	2.4
GaAsBi	7.5	9.5		2.4

Figure 1. HR-XRD rocking curves of InGaAs, InGaAsBi and GaAsBi MQWs.

In conclusion, the GaInAsBi/GaAs MQWs were grown on GaAs substrates. The influence of the substrate temperature and the Bi flux was investigated. It has been found that the best PL results were obtained from layers grown at 270 ^{o}C temperature. Such MQWs could be used as active regions of the light emitting or laser diodes.