

Indium accumulated layer control to sharp InGaAs/(Al)GaAs QW interfaces

A.A. Marmalyuk¹⁾, A.V. Petrovsky¹⁾, O.I. Govorkov²⁾, D.B. Nikitin¹⁾, A.A. Padalitsa¹⁾, P.V. Bulaev¹⁾, I.D. Zalevsky¹⁾

1) Sigm Plus Co., 3 Vvedenskogo Str., 117342 Moscow, Russia, 2) RDInstitute "Polyus", 3 Vvedenskogo Str., 117342 Moscow, Russia

It is well known that during epitaxial growth indium atoms are partially accumulated on the growing surface. As a result the broadening of QW interfaces takes place, the shape of the QWs strongly depends on properties of accumulated layer. Using this concept the basic methods of indium segregation suppression – growth interruptions and InAs predeposition, were analysed. The relation between parameters of accumulated layer and mechanical stresses in heterostructure grown by MOCVD was obtained. It was shown that the mechanical stress control allows effective influence on indium atoms distribution.

Six types of InGaAs/(Al)GaAs DQW heterostructures were grown by MOCVD at temperature 720 °C and pressure 60 torr on (001) n+-GaAs substrates. High resolution Auger electron spectroscopy and photoluminescence measurements were used to investigate InGaAs QW profile.

According to common used model the indium atoms during epitaxial growth have a preferable tendency to move into accumulation adatoms layer rather than to build crystal lattice. Therefore the form of indium profile may be corrected controlling accumulated layer capacitance and behavior during epitaxial growth. Growth interruption at top interface leads to sharp QW profiles. The effect of additional purging at bottom interface on In distribution is insufficient. One of probable approaches to improve bottom interface of InGaAs/AlGaAs QWs is indium predeposition. As for accumulated layer properties the indium atoms predeposition allows to saturate accumulated layer. As a result minimum bottom interface length can be observed. Sample with predeposition demonstrates sharper bottom interface as compared with reference sample. InGaAs/(Al)GaAs QW is strained QW and hence it can be expected that mechanical stresses affect on parameters of segregation process. From the point of view of accumulated layer the strain changes its capacity. One of possible ways to increase strain in InGaAs/(Al)GaAs QW is the introduction of strained buffer layer before QWs. We used In_{0.16}Al_{0.28}Ga_{0.56}As layers for introduce strain in region of active InGaAs QWs and do not distort band diagram. As a result the active InGaAs/(Al)GaAs QWs have practically the same indium content and interface sharpness. While the indium content of two SBL layers are quietly different.

Thus the form of MOCVD grown InGaAs/(Al)GaAs QW interfaces can be controlled by growth interruption, indium predeposition and strain control.