Atomic Hydrogen Assisted Selective MBE Growth of InGaAs Ridge Quantum Wire Honeycomb Network Structures for Binary-Decision Diagram Quantum LSIs

Akira Ito, Tsutomu Muranaka, Seiya Kasai and Hideki Hasegawa

Research Center for Interface Quantum Electronics & Graduate School of Electronics and Information Engineering, Hokkaido University, Sapporo 060-8628, Japan
Phone:+81-11-706-7174, Fax:+81-11-716-6004, e-mail:akira@rciqe.hokudai.ac.jp

Abstract

Novel hexagonal quantum circuits based on the binary-decision diagram (BDD) architecture have been recently proposed by our group towards next generation quantum LSIs (Q-LSIs) operating at room temperature. In this paper, feasibility of InGaAs ridge quantum wire (QWR) honeycomb network structures for such quantum circuits is investigated using atomic hydrogen (H*)-assisted selective MBE. The fabricated structures were characterized in detail by SEM, AFM, PL and CL measurements. By using patterned substrates with wire directions of <100>-<$\bar{1}$10> and <510>-<$\bar{1}$10> together with optimized H*-assisted selective MBE, honeycomb networks of the sharp and uniform InGaAs ridge structures were realized. Embedded InGaAs QWR honeycomb networks were successfully formed on the ridge structures. The growth technique was further optimized for formation of sub-micron pitch honeycomb structures, which corresponds to integration of BDD node devices up to 10^8 devices/cm^2.