Compositional and strain analysis of InAs quantum wires with InGaAlAs barrier layers

Kai Cui [a,*], Michael D. Robertson [b], Brad J. Robinson [c], Carmen M. Andrei [a], David A. Thompson [c], Gianluigi A. Botton [a,c]

[a] *McMaster University, Department of Materials Science and Engineering, 1280 Main St. W., Hamilton, ON, L8S 4L7, Canada.*

[b] *Acadia University, Department of Physics, Wolfville, NS, B4P 2R6, Canada.*

[c] *McMaster University, Center for Emerging Device Technologies, 1280 Main St. W, Hamilton, ON, L8S 4L7, Canada.*

Semiconductor quantum wire (QWR) structures have attracted significant attention due to their potential application in long wavelength (1.5 2 Âţm) lasers. Compositional analysis at high spatial resolution is a crucial component of the detailed characterization necessary to understand both the growth mechanism and optoelectronic properties of the QWRs. In this study, the quantitative composition analysis by electron energy loss spectroscopy spectrum-imaging (EELS-SI) for the InAs QWRs bound by InGaAlAs barrier layers (BLs) lattice-matched to the InP substrate was applied to both single and multi layer QWR samples.

Three different regions were detected in the indium concentration map for individual QWRs. (1) An indium rich center containing 70 75

Compositional analysis performed in the multilayer QWR samples revealed that the alignment of the QWRs was determined by the propagating direction of the indium-rich stripes within 15 nm spacer layer (SL) between adjacent layers, as shown by the EELS-SI.

In conclusion, quantitative compositional analysis at high spatial resolution provides insights necessary to further model the physical properties and to understand the growth of the QWR nanostructures.

* Corresponding author.
Email addresses: gbotton@mcmaster.ca (Kai Cui), gbotton@mcmaster.ca (Gianluigi A. Botton).