μ-EXAFS, μ-XRF, and μ-PL Characterization of a Multi-Quantum-Well Electroabsorption Modulated Laser Realized via Selective Area Growth

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In the past few years, strong efforts have been devoted to improving the frequency of optical-fiber communications. In particular, the use of a special kind of integrated optoelectronic device called an electroabsorption modulated laser (EML) allows communication at 10 Gb s^{-1} or higher over long propagation spans (up to 80 km). Such devices are realized using the selective area growth (SAG) technique and are based on a multiple quantum well (MQW) distributed-feedback laser (DFB) monolithically integrated with a MQW electroabsorption modulator (EAM). Since the variation in the chemical composition between these two structures takes place on the micrometer scale, in order to study the spatial variation of the relevant parameters of the MQW EML structures, the X-ray microbeam available at the ESRF ID22 beamline is used. The effectiveness of the SAG technique in modulating the chemical composition of the quaternary alloy is proven by a micrometer-resolved X-ray fluorescence (μ-XRF) map. Here, reported micrometer-resolved extended X-ray absorption fine structure (μ-EXAFS) spectra represent the state of the art of μ-EXAFS achievable at third-generation synchrotron radiation sources. The results are in qualitative agreement with X-ray diffraction (XRD) and micrometer-resolved photoluminescence (μ-PL) data, but a technical improvement is still crucial in order to make μ-EXAFS really quantitative on such complex heterostructures.

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