Raman and AFM Profiling of Quantum Dot Multilayers

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InAs/AlGaAs quantum dots (QDs) are of a great interest for optoelectronic applications since they have interband transition energies in the visible spectral range. InAs/AlAs and InAs/$Al_{0.75}Ga_{0.25}As$ modulated QD structures were prepared by molecular beam epitaxy in the Stranski-Krastanov growth mode on (001)-oriented GaAs substrates. The structures contain five blocks separated by GaAs layers and each consisting of ten InAs QD layers with periods of 50 and 100 nm in Al(Ga)As matrices. The cleaved (110)-oriented edges of the samples were studied by atomic force microscopy (AFM) and Raman spectroscopy. AFM images correlate with transmission electron microscopy results and allow individual QD layers due to partial oxidation of the AlAs or AlGaAs matrices to be resolved (Fig.1). Raman spectroscopy from a cleaved surface allows profiling the Raman intensity of phonon modes. For a better access to the spatial changes in the phonon spectra, the samples were wedged at an angle of 5 – 7 degree with respect to the sample surface which allowed us to resolve Al(Ga)As matrices and intermediate GaAs layers (Fig.1).

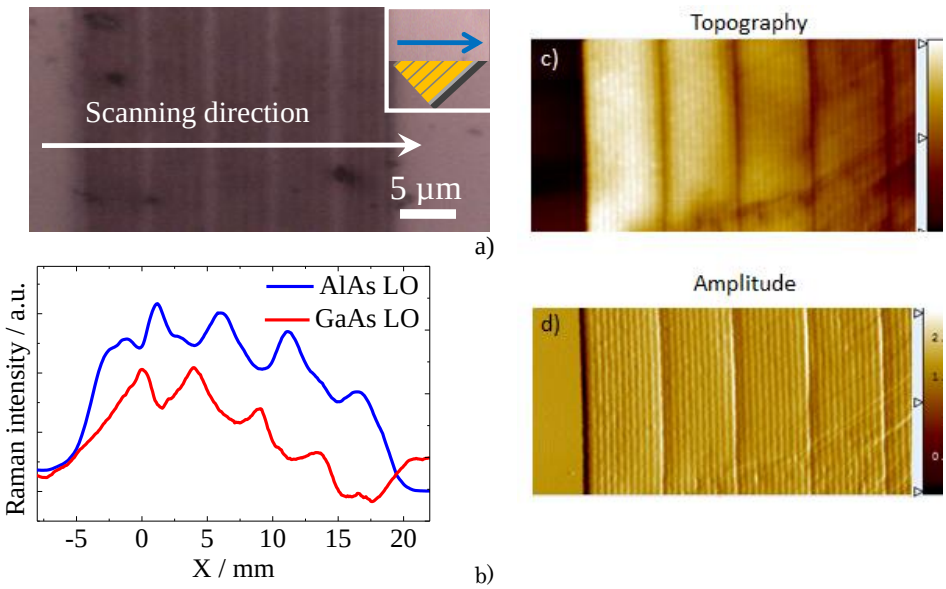

Fig. 1. Raman and AFM profiles obtained on the wedge and (110)-edge of InAs/AlAs QD structure. a) optical microscopy view of the wedged sample. The inset shows the scanning direction in the side view. b) Modulation of Raman signal intensity in the wedged sample demonstrating resolution of individual blocks. c) and d) Topography and amplitude AFM images, respectively, of a cleaved InAs/AlAs QD structure.

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