

Raman study of self-assembled InAs quantum dots embedded in AlAs: influence of growth temperature

D. A. Tenne^a, A. K. Bakarov^a, A. I. Toropov^a and D. R. T. Zahn^b

^a Institute of Semiconductor Physics, pr. Lavrenteva 13, 630090 Novosibirsk, Russia

^b Institut für Physik, Technische Universität Chemnitz, D-09107 Chemnitz, Germany


Available online 20 January 2002.

Abstract

Phonon spectra of self-assembled InAs quantum dots (QDs) in an AlAs matrix were studied by Raman spectroscopy. A series of InAs QDs was grown by molecular beam epitaxy at substrate temperatures varied in the range of 420–550°C. The observed asymmetric line shape of LO phonons in InAs QDs and its low-frequency shift with increasing excitation energy are explained by QD size distribution and phonon confinement in small-size dots. Phonons of the InAs wetting layer are also observed in the Raman spectra of QD structures. Two bands of interface phonons in the AlAs frequency region are attributed to phonons associated with two types of interfaces: the planar interface wetting layer/AlAs matrix and the three-dimensional QD/matrix interface. A comparison of the position and the line shape of phonon features of InAs QDs grown at different temperatures reveals that dots grown at low temperatures (~420°C) have the smallest average size. Increasing the temperature leads to the formation of larger InAs islands. At temperatures higher than 520°C partial re-evaporation of InAs occurs.

Author Keywords: Self-assembled quantum dots; Phonons; Raman spectra

PACS classification codes: 63.22.+m; 78.30.Fs

 Corresponding author. Tel.: +7-3832-341945; fax: +7-3832-332771; email: tenne@thermo.isp.nsc.ru