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Optical Gap Bowing and Phonon Modes of Amorphous Ge1-x-ySexAsy Thin Films

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We investigated the optical properties of Ge1-xSex and Ge1-x-ySexAsy amorphous semiconductor films using spectroscopic ellipsometry and Raman spectroscopy. The dielectric functions and absorption coefficients of the amorphous films were determined from the measured ellipsometric angles. We obtained the optical gap energies and Urbach energies from the absorption coefficients, and found a strong bowing effect in the optical gap energy of Ge1-x-ySexAsy where the endpoint binaries were Ge0.50Se0.50 and Ge0.31As0.69. Based on the correlation between optical gap energies and Urbach energies, the large bowing parameter was attributed to the electronic disorder. We found the composition dependence of several phonon modes using Raman spectroscopy. For Ge1-x-ySexAsy, the D mode (232-267 cm-1) changed from As-As (or As3 pyramid), to As(Se1/2)3 pyramid, and finally to Se clusters, as the Se composition increased. Resonant Raman phenomenon was observed in Ge0.38Se0.62 at a laser excitation of 514 nm (2.41 eV). We verified that this laser energy corresponds to the transition energy of Ge0.38Se0.62 using the second derivative of the dielectric function of Ge0.38Se0.62.

Keywords: Ge1-x-ySexAsy, amorphous films, dielectric function, band gap, Urbach energy, phonon

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Optical Emission Anisotropy in InP Aligned Quantum Dots

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InP quantum dots were grown by using the molecular beam epitaxy technique. Quantum dots are connected and composed string-like one-dimensional structure due to the strain field along [110] crystal direction. Two prominent photoluminescence transitions from normal quantum dots and string-like one-dimensional structure were observed which show strong optical anisotropy along [1-10] and [110] crystal directions. Both peaks also showed blue-shift while rotating emission polarization from [1-10] to [110] direction. Such optical transition behaviors are the consequence of the valence band mixing caused by strain field along the [110] crystal direction.

Keywords: InP, Quantum dot, photoluminescence