

Structure dependence of LO phonon-resonant radiation from undoped GaAs-metal surface micro-stripe structures

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Small interaction energy width with photon is an advantage of phonon in single-crystal semiconductors over electronic system. This advantage is considered to be applicable to optical devices in IR to THz wave region. Previously, emission by surface phonon polariton using nanostructures of gratings, nanopillars, and so forth have been reported, where metal structures have been avoided from viewpoints of the loss of energy and broadening. However, we have reported eminent absorption and electric-dipole emission of s-polarized THz light resonating with the LO phonon energy from metal-GaAs surface stripe structures.[1] In this report, we discuss the dependence of emission properties on the structure dimensions of stripes: metal semiconductor width and mesa height.

Mesa stripe structures were fabricated by photolithography using a solution including H_2SO_4 , H_2O_2 and H_2O . Stripe width was controlled in a range from 2 μm to 17 μm . Mesa-height was controlled from 0 to approximately 1.5 μm . Figure 1 shows examples of emission spectra at approximately 630 K for the u-GaAs mesa-stripe with of 6 μm . We have observed a peak at the LO phonon energy for samples for the mesa width narrower than 10 μm , while for wider stripes, the thermal emission structure is approximately equal to that for the sample without stripes. Figure 2 shows an example for the 17 μm stripe width. Further, it was observed that when mesa height is increased to 1.5 μm , the emission intensity increases linearly. These results indicate that the LO phonon resonant emission efficiency is based on the coherence of the LO phonon in the stripe structures.

[1] Y. Ishitani et al. Appl. Phys. Lett., **113**, 192105 (2018)

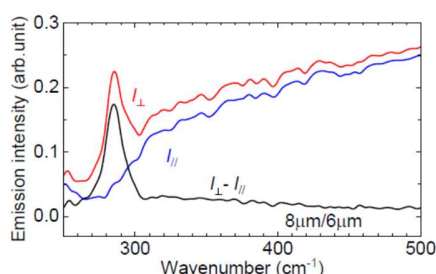


Fig. 1 Emission spectra for the structure of 6 μm GaAs mesa width.

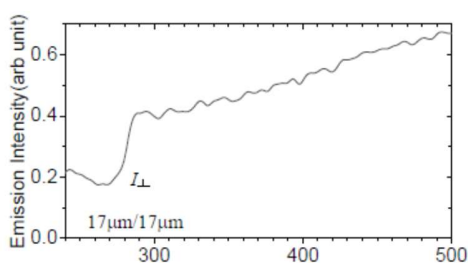


Fig. 2 Emission spectra for the structure of 17 μm GaAs mesa width.