THz Quantum Photodetector based on LO-phonon scattering-assisted extraction

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The use of the LO-phonon scattering mechanism has proven effective to enhance electron transfer between quantum wells in diverse intersubband devices, such as Mid IR QCDs [1] and Mid IR and THz QCLs [2,3]. In this work we present a THz quantum detector based on GaAs/$Al_{0.25}Ga_{0.75}As$ heterostructure which is designed to exploit LO phonon scattering as an extraction mechanism for photoexcited electrons. As shown in Figure 1a) the absorbing quantum well has an intersubband transition of 15.5 meV. When an electric field is applied, a miniband is formed in the subsequent quantum wells, the edge of which is aligned resonantly with the first subband of the next period's absorbing quantum well, exhibiting a transition at roughly the LO phonon energy in GaAs E_{LO}= 37 meV. Spectral-resolved measurements were performed on samples processed into arrays of patch microcavities [4]. Figure 1 b) shows the responsivity spectrum of the device taken at 20 K exhibiting a peak response at 3.5 THz with a maximum value of 80 mA/W. This type of quantum detectors allows exploiting the degrees of freedom of quantum confinement for a constant Al content.

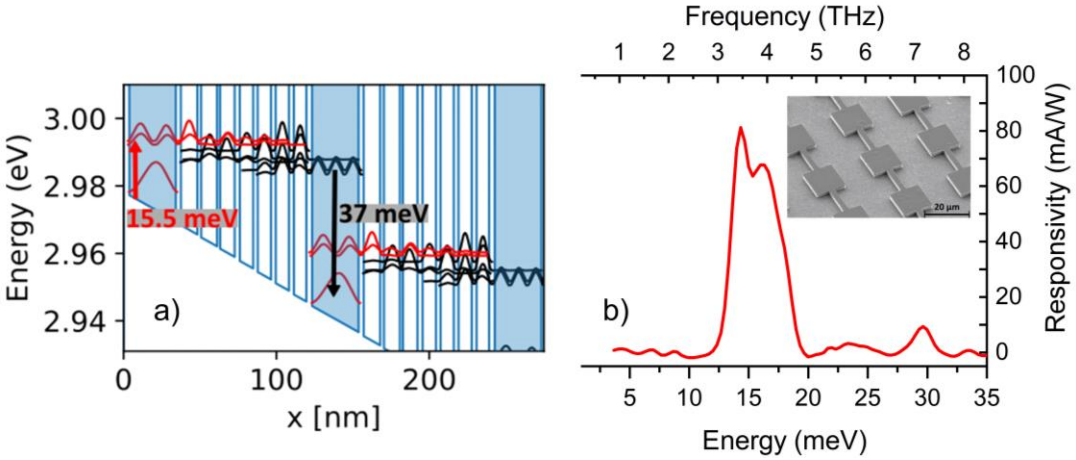

Figure 1 a) Conduction band profile of the device based on a GaAs/$Al_{0.25}Ga_{0.75}As$ system, under an electric field of $F = -2.8$ kV/cm. Two complete periods are displayed, each of them starting with an active quantum well which is highlighted in blue. b) Responsivity spectrum of the device taken at 20 K. Inset: SEM image of a section of a patch microcavity array.

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