Low doping level and carrier lifetime measurements in InAs with a novel THz characterization technique

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In this abstract, we present a novel, contactless opto-THz technique for measuring low doping levels and carrier lifetime in InAs. Preliminary studies proved that THz waves can be modulated using an optically-pumped InAs slab [1]. This optically-driven modulation is efficient in the 0.75–1.1-THz frequency band because of its vicinity with the plasma frequency of electrons, that leads to a strong dependence of the real and imaginary parts of the dielectric permittivity of InAs on free carrier density, the latter being strongly increased using optical pumping. Additionally, without any optical pumping, we show that n-type doping levels around 10^{16} cm^{-3} could be measured thanks to THz transmission measurements analyzed using a single-variable Drude-Lorentz model, as shown in Fig. 1(a), thus offering an original and accurate technique to measure very low doping levels. Using an amplitude-modulated optical pump, we could also easily retrieve the effective carrier lifetime by measuring the transmission of a THz probe signal, as shown in Fig. 1(b).

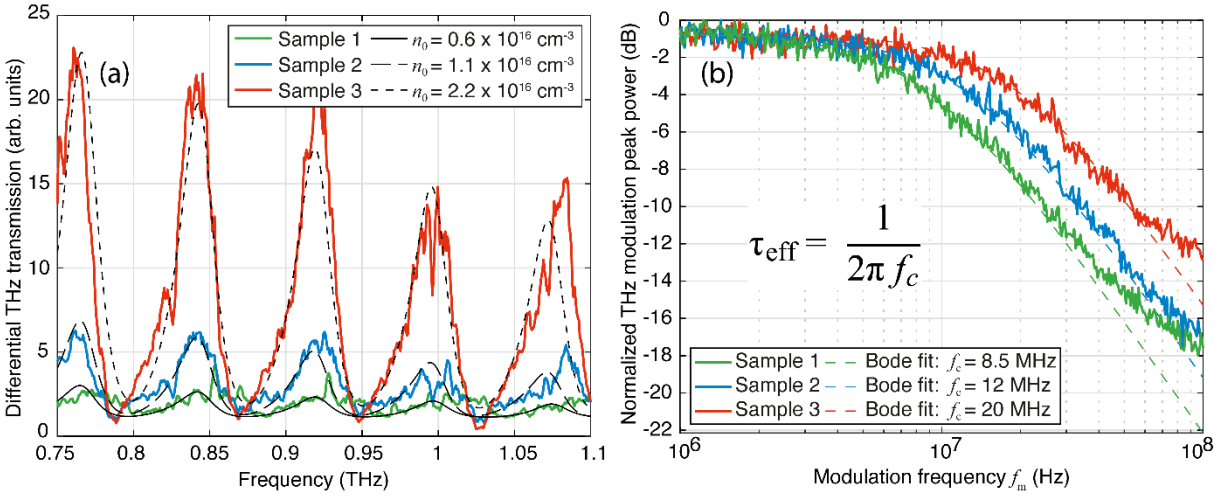

Figure 1. (a) Differential THz transmission measurement: transmission through substrate only (500 µm of GaAs) divided by the sample transmission (5 µm of InAs on GaAs substrate). Black curves correspond to the model fittings. **(b)** Typical THz modulation Bode spectrum at 0.81 THz under 10 W/cm^2 mean optical density. The bandwidths give information about the carrier effective lifetime in the three InAs samples.

[1] E. Alvear-Cabezón, Appl. Phys. Lett. 117(11), 111101 (2020).

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