Investigation of the effective mass in $GaAs_{1-y}N_y$

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Dilute nitride semiconductors (DNS), such as $GaAs_{1-y}N_y$, with a nitrogen content y of a few percent or even less, have recently attracted considerable interest due to the giant bowing effect. That, in turn, offers the possibility to tailor the band structure of new devices, like LEDs, lasers, solar cells, and infrared photodetectors by varying the nitrogen content [1]. Determining proper values of the effective mass (EM) of DNS is a topic of interest because of the inconsistency of previous results (e.g. [2, 3]). To clarify the conflict we study a series of GaAsN samples ($y = 0\% - 1\%$) by cyclotron resonance (CR) spectroscopy, Fourier transform infrared spectroscopy and photoluminescence spectroscopy in magnetic fields in order to deduce the EM via the CR frequency, plasma frequency and the diamagnetic shift, respectively. So far, we are able to show that the discrepancies of

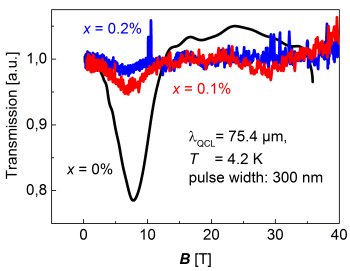

Figure 1: Determination of the EM by CR spectroscopy.

former publications are most likely caused by the particular choice of the experimental technique. Probably the most direct and reliable method is the CR spectroscopy, which has rarely been used due to the low electron mobility in GaAsN. Figure 1 illustrates that the CR does not significantly change with different N contents and thus the EM. Our magneto-PL spectroscopy results exhibit a huge increase of the EM with the N content ($m^*_{0\%} = 0.07m_e, m^*_{0.1\%} = 0.23m_e, m^*_{0.2\%} = 0.41m_e$) which is even bigger than in previous publications and in contrast to the CR result. The investigation of the diamagnetic shift of the electron to carbon impurity transition is a common technique (e.g.[2]) for the EM determination and is dominated by the identification of the slope s of ΔE. Our experiment shows a strong dependence of this value on the magnetic field region of interest. In our opinion, this method is not accurate enough for the EM determination.

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