Magneto-THz spectroscopy in dense two-dimensional electron systems

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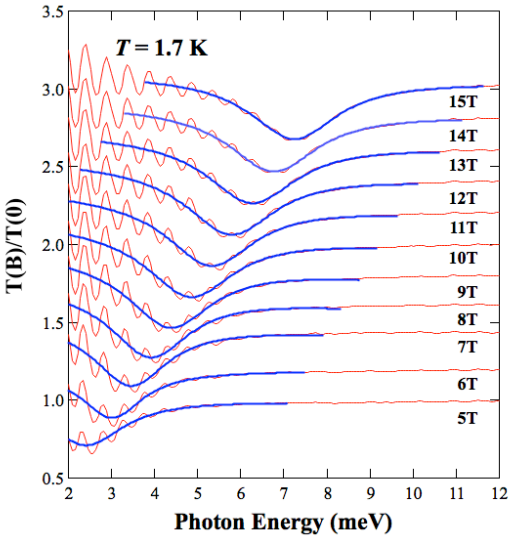
Various research on quantum nanostructures have been continued in semiconductors such as Si and GaAs based on the epitaxial growth and nanofabrication technology so far. Recent progresses of these technologies also enable us to study the quantum nanostructures in a variety of compound semiconductors. In the research of the quantum Hall effect, which is the magneto-transport phenomena for the two-dimensional electron systems under the high magnetic field, not only III-V semiconductors but also II-VI semiconductors have been employed recently.

On the other hand, magneto-optical measurements also become the strong tools for investigating anomalous properties in quantum Hall systems with the dense two-dimensional electron under the magnetic field. The Fermi-edge singularity, the charged exciton, such topics in relation to the interband transition have been investigated with using the luminescence and absorption measurements.

Furthermore, between the Terahertz wave and millimeter wave region, cyclotron resonance, which is the intraband transition between quantized Landau levels in the magnetic field, has been used for investigating the carrier effective mass and various interactions in the two-dimensional systems.

The cyclotron resonance measurements are performed normally in the low carrier density regime. When the plasma frequency becomes comparable to the cyclotron frequency in high mobility systems, unusual magneto-transmission can be expected. Such dense electron concentration beyond n~10^{12}cm^{-2} can be realized at the heterointerface based on a large spontaneous polarization effect in GaN or ZnO, and it is possible to study the magneto-transmission with the high carrier density and the high mobility only in the two-dimensional electron system confined in a thin layer.

Figure shows the magneto-transmission in a GaN heterostructure with using a FT-IR spectrometer under magnetic fields up to B=15T. The cyclotron resonance is observed clearly, and the two-dimensional electron mass in GaN was determined accurately [1].



In this talk, I will introduce the recent results of the anomalous cyclotron resonance in two-dimensional electron systems using magneto-spectroscopic measurements, focusing on the high plasma frequency regime.

[1] D. Kindole, Y. Imanaka *et. al.*, J. Korean Physical Society, 74, 159-163 (2019).