Magnetoplasmons in devices based on high-quality CdTe/CdMgTe quantum wells

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Since the first observation of plasmons in Si inversion layers in 1977 [1], the field of plasmonics in two dimensions (2D) has been continuously developing. In 1993, Dyakonov and Shur theory [2] predicting a plasma wave generation and amplification by a *dc* current instability in a field effect transistor (FET) was presented. The significance of this idea is that it predicts a possibility to use FETs as compact THz emitters and detectors, both resonant and non-resonant, controlled by the channel current and the gate voltage. Since then, FETs based Si, GaAs, GaInAs and GaN have been investigated and an essential progress has been achieved both in the applied and fundamental aspects of the problem.

The goal of our work was to investigate a 2D electron plasma in high quality MBE-grown CdTe/CdMgTe quantum wells and to find out whether this II-VI material is suitable to fabricate FET devices for THz detection. Metallic grid antennas with different grating periods, allowing for an efficient coupling of the incident THz wave and 2D plasma waves, were deposited on the top surface of the structures. A sample with a quantum point contact defined by lateral gates was also investigated. All experiments were carried out at the Faraday configuration at 1.8 K and in magnetic fields B up to 12 T provided by a superconducting coil. An optically pumped THz laser was used as the source of the radiation which was directed to the sample through an oversize metallic waveguide.

Magneto-transmission spectra of the samples with grid couplers demonstrate a high cyclotron resonance (CR) peak which is accompanied at the low-B shoulder with a few spectral features. They are interpreted as the fundamental and higher order modes of magnetoplasmon resonances. The wavevectors of magnetoplasmons are related to the period of the grid. An analysis reveal that these magnetoplasmons follow a dispersion relation for plasmons totally screened by the grid metalization.

For the quantum point contact sample, photocurrent was investigated as a function of B. A CR peak is accompanied with several maxima which are interpreted as magnetoplasmon excitations. In this case, the magnetoplasmons follow a dispersion for unscreened plasmons and their wavevectors are defined by geometrical features of the mesa defining the point-contact structure.

To conclude, both screened and unscreened magnetoplasmons were observed in 2D plasma devices based on CdTe/CdMgTe quantum wells. The results show a possibility to tune magnetoplasmon dispersion both by geometrical features of the device and gate metallization.

[1] S. J. Allen, D. C. Tsui and R. A. Logan, Phys. Rev. Lett. **38**, 980 (1977).
[2] M. Dyakonov and M. Shur, Phys. Rev. Lett. **71**, 2465 (1993).