Magneto-Oscillations Induced by Frequency-Modulated MW-Irradiation in 2DES on Liquid Helium Surface

L. V. Abdurakhimov, A. O. Badrutdinov, and Denis Konstantinov

Okinawa Institute of Science and Technology (OIST), Japan

We report about recent progress in investigations of magneto-oscillations induced by microwave (MW) irradiation observed previously in the two-dimensional electron system (2DES) on liquid helium.[1] 2D electron layer was formed on the surface of liquid helium-4 at the temperature of about 0.1 K. Electron transition between the two lowest energy subbands $1 \rightarrow 2$ was induced by MW irradiation. In addition, magnetic field was applied perpendicularly to the electron layer which caused Landau quantization of the electron in-plane motion energy. A conductivity of 2DES was measured by Sommer-Tanner technique. The magneto-oscillations were observed which resulted from elastic electron scattering from the excited low number Landau level of the second subband to a high number Landau level of the first subband. Since subbands energy difference depended on holding electric field, dependence of magneto-oscillation magnitude on holding voltage had a resonance form. It was found that the resonance width was two orders greater than expected one which can be attributed to local origin of magneto-oscillations due to electric field spatial inhomogeneity. To overcome this, we used frequency modulated (FM) MW irradiation. Indeed, we observed increase of magneto-oscillations magnitude depending on FM modulation frequency. From this dependence we estimated time of electron energy relaxation from the second subband to the first subband which was found to be of the order of 1 microsecond.

1. D. Konstantinov and K. Kono, Phys. Rev. Lett. **103**, 266808 (2009); D. Konstantinov and K. Kono, Phys. Rev. Lett. **105**, 226801 (2010)

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