Thermal Emission of THz Radiation from Field Effect Transistors

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Properties of THz radiation, especially its non-invasive interaction with biological tissues and a low absorption in many materials stimulated a broad research- and applications-oriented activity. A steady progress in development of THz detectors resulted, e.g., in commercially available multipixel arrays operating at a video rate. However, most of current applications are based on non-resonant detectors because resonant ones, especially these working at room temperature, are still under development, in spite of a huge market and scientific demand. This shows an interesting path of investigations which could lead to fabrication of a resonant and tunable THz detector. On the other hand, modern THz applications need compact, efficient and cost-effective sources of radiation, possibly - spectrally selective ones. THz emitters available nowadays are typically large (like CO_2 - pumped lasers) and/or expensive (BWOs, frequency multipliers) so generation of THz radiation is even more perplexing than its detection.

We show results of spectrally sensitive measurements of a THz radiation emitted from FETs. A thin film of a high electron mobility InSb sample was used as a detector. Measurements were done at liquid helium temperatures in magnetic fields up to about 3 T with a modulated on/off biasing of the drain of a FET. A resulting emitted radiation was registered with the InSb detector placed in the magnetic field. An incident radiation causes transitions between Landau Levels in the conduction band of InSb (a cyclotron resonance transition) which leads to changes in the detector conductivity. Changing the magnetic field one gets a spectral tuneability of the detector.

The source of THz radiation was a commercially available GaAs/AlInAs FET. Additionally, as a reference source of radiation, a thermal source (a carbon resistor) was used. We compared thermal radiation spectra of the resistor with these of the FET (see Fig. 1). By applying an appropriate numerical treatment of the data, for the first time we show the spectrally resolved emission data. We show the FET emission is mainly of a thermal character. The differences between them are discussed.

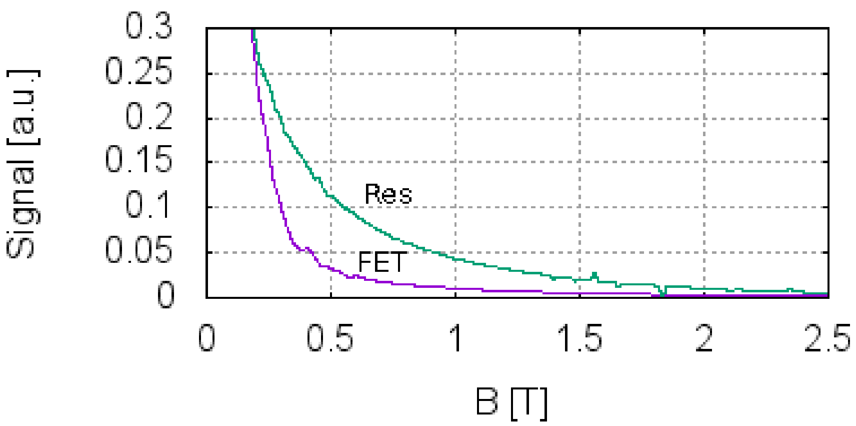

Fig. 1. Spectra of thermal emission originating from carbon resistor and FET. $T = 4.2$ K.