THz optical element for the field effect transistor detectors

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Summary: Detection of terahertz radiation is a very promising technique. For many potential applications (biology, security, telecommunication) detectors separated in frequency domain are necessary.

1 Introduction

The detection of terahertz radiation with field effect transistors was presented in many papers [1,2]. The process of detection takes place in 2D electron gas in FET channel. To work e.g. as an amplifier transistor should be applied at frequencies well below f_T (transition fequency) [3]. Detection of THz radiation is possible because its mechanism is connected with plasma waves, which are much faster than the drift velocity of electrons, connected with f_T [4]. Under the special condition, when radiation frequency is tuned to plasma frequency, the resonance detection can be observed [5]. If the electron concentration and mobility in the transistor channel are not high enough, the detection became non-resonant. Planar metallic antennae, placed on the surface of the detector, can be used to improve coupling between the electromagnetic radiation and the 2D channel and to define the frequency range of the detection.

2 Measurement

The detectors with patch antennae placed on the Si MOSFET were investigated (Fig 1). The antennae were capacitive coupled with the transistors through a thick photoresist layer, as it was described in paper [6].

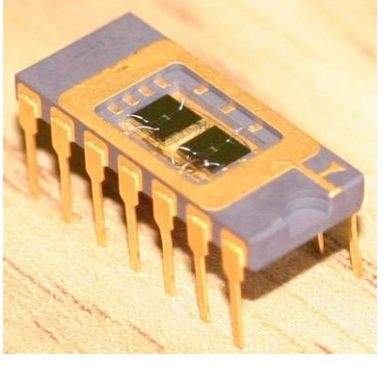

Figure 1: Example figure of the detector in ceramic holder.

The response signal from the detector was measured. The THz radiation was generated by Virginia Diodes source based on a frequency multiplication.

When the detectors are tested they can be placed directly in front of the source, but for long distance applications the optical elements are necessary.

In this contribution the plastic lens made of HDPE (High Density PolyEthylene) was used, shown in Figure 2. The lens was double sided and had a diameter of 100 mm with a focal length of 100 mm. It was designed in a form of a high-order kinoform [7].

Figure 2: Plastic diffractive lens used in the experiment.

3 Conclusion

The frequency selectivity was obtained thank to proper antennae coupled to FETs channel. A plastic diffractive lens was used to improve the detection process.

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