Terahertz detector with series connection of asymmetric gated transistors

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Abstract. Terahertz (THz) detection by a one-dimensional array of series connected field-effect transistors (FETs) is studied experimentally. Such terahertz detector demonstrates greatly enhanced voltaic responsivity up to 2 kV/W. Asymmetrical position of the gate contact in each FET in the array enables strong photovoltaic response.

1. Introduction and background

Recent years have witnessed further progress in THz detection based on plasmonic nonlinearities in a FET with two-dimensional (2D) electron channel, which was originally proposed in [1]. Resonant [2],[3] as well nonresonant [4],[5] plasmonic detectors has been studied.

In Ref. 5, we have shown that a densely ordered 1D array of FETs with asymmetrical position of the gate contact in each FET can be used as a THz detector with enhanced responsivity without using supplementary antenna elements. But we have used a parallel connection of FETs in this work and the enhanced responsivity was related to the single FET in array while the voltaic responsivity of the overall array was relative low. After we made 1D array of series connected such FETs and measured its voltaic responsivity.

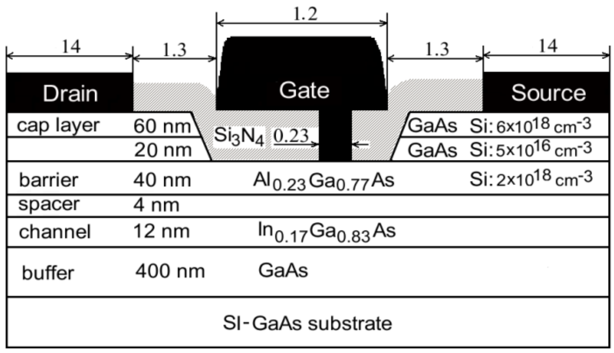

Figure 1. Schematic of an individual FET in the array (all lateral dimensions are given in microns).

2. Results
Single FET and transistor's structure are on figure 1 and 2.

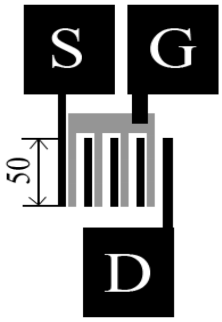

Figure 2. Top view of the detector array.

Measured photoresponse are on figure 3.

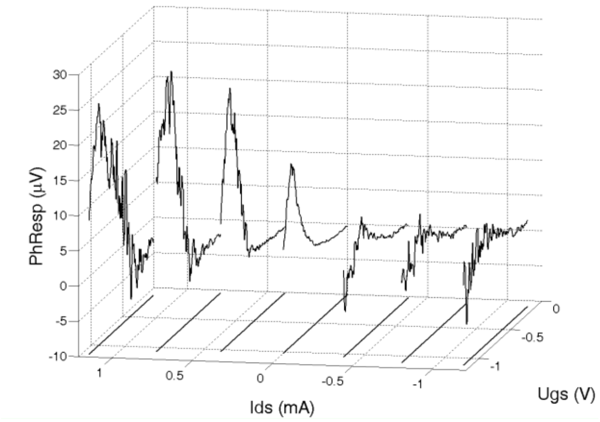

Figure 3. The dependence of the photoresponse on the gate-source voltage and the drain-source current at 0.6 THz (line at the bottom of the chart is the corresponding projections of the photoresponse curves on the coordinate plane XY).

The maximum sensitivity of the photovoltanic response is 1095 V/W. Increased sensitivity by passing the bias current is 1910 V/W at Ids = 0.77 mA. These values are better than into Ref. [6].

References

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