S6-O5

Electronic THz beam modulation with CMOS transistor switches

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In response to the growing demand for higher data transfer rates in wireless communication systems, electronic devices are now beginning to penetrate the least developed region of the terahertz frequency spectrum. A practical communication link necessitates a multitude of components, including THz transmitters, receivers, passive optical elements, and fast modulators [1,2].

This work presents an electronic sub-THz modulator based on a 3×3 element array with field-effect-transistor-based switches implemented in a 180-nm silicon CMOS technological process [3]. The signal transmitted through the device may be modulated by modifying the impedance of the transistor which is coupled to a resonant antenna.

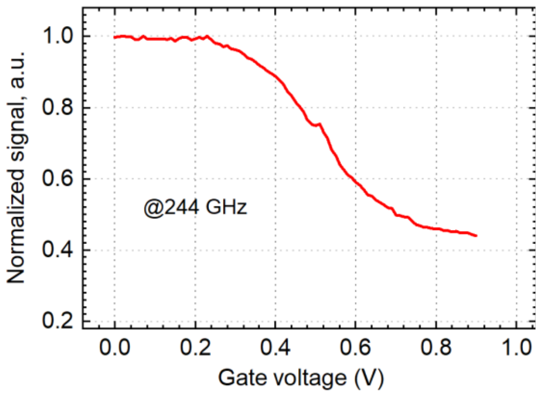

Fig. 1 The transmitted signal dependency on the 3x3 CMOS detectors array bias voltage. The frequency of THz beam – 244 GHz.

Figure 1 illustrates the dependence of the normalized transmitted signal on the applied gate bias voltage. The highest signal level is achieved at a low gate voltage when the transistor channel is in a high-impedance state. Above the threshold voltage, the channel becomes conductive resulting in increased absorption by the transistor and reflection by the antenna corresponding to a reduction in the transmitted signal level. The maximum modulation depth of 56% was achieved at the frequency of 244 GHz being close to the simulated antenna resonance frequency. Based on our simulations using the foundry-provided model, we predict that the utilized transistor, with a 180 nm length and 2 μm width, should possess a short-circuit current gain frequency f_t of 50 GHz which can be directly translated to the maximum modulation frequency of our switch. Therefore, the system based on the state-of-the-art transmitter, receiver, and presented modulation element should allow for achieving data throughput reaching 100 Gbps rates.

REFERENCES

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