Zero-Bias Power Detector Circuits based on MoS_2 Field Effect Transistors on Wafer-Scale Flexible Substrates

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This contribution discusses the design, fabrication, and characterization of wafer-scale, zero-bias power detectors based on two-dimensional MoS_2 field effect transistors (FETs) on a flexible Polyamide (PI) substrate [1]. The performance of two CVD-MoS_2 samples (monolayer and multilayer), grown with different processes, is analyzed and compared starting from material growth, through device fabrication and characterization steps to the circuit level. By relying on the nonlinearity of the channel conductivity, the operation frequency of the circuit is between 12 and 18 GHz, with a demonstrated voltage responsivity of 45 V/W at 18 GHz for the monolayer MoS_2 and 104 V/W at 16 GHz for the multilayer. The measured dynamic range exceeds 30 dB, outperforming other semiconductor technologies like CMOS circuits [2] and GaAs Schottky diodes [3]. In addition, since the circuits operate without DC bias, they also have zero DC power consumption. These results make them the best performing power detectors fabricated on flexible substrate reported to date. The concept could be extended to future generations of flexible 2D microwave circuits [4].

References

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Figures

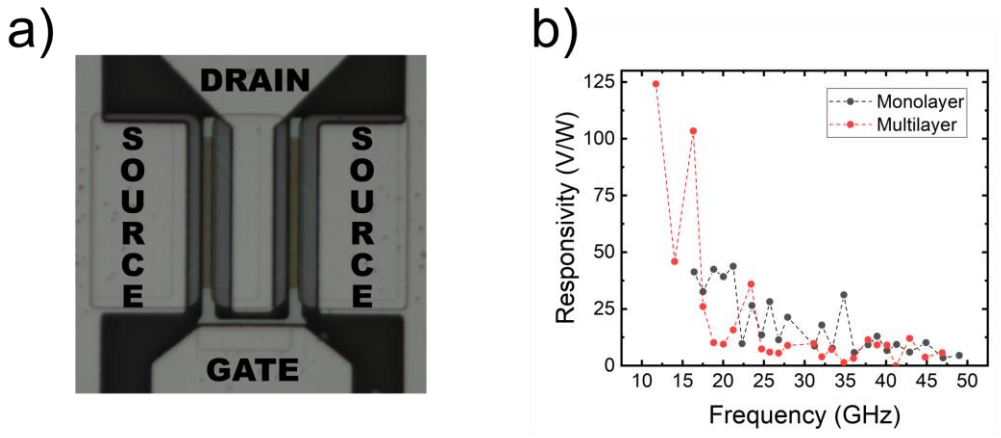

Figure 1: a) Optical micrograph of one of the fabricated MoS_2 devices, the channel dimensions are 5 x 60 µm. b) Comparison in responsivity of the two power detector circuits.