Integrated RF Rectifier using CVD Graphene Monolithic-Microwave-Integrated-Circuit Process on a Polymide Flexible Substrate

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Abstract

This work presents a fully integrated RF rectifier on a flexible polymide (PI) substrate. This circuit is designed and implemented using a chemical-vapor-deposition (CVD) graphene monolithic microwave integrated circuit (MMIC) process, where a metal-insulator-graphene (MIG) diode [1] is employed to obtain the nonlinearity. The smooth surface enables good TiO_2 barrier interface formation and a higher carrier transport performance of the graphene. Passive components are implemented on the same substrate and a large-signal diode model is created based on measured results on a test key. A rectifier is deliberately designed for eliminating the input matching network [2] by properly sizing the MIG diode, and the DC output load impedance. Removing the matching network results in compact size and reduces the loss of the input of the rectifier. Measured input reflection coefficient, S_{11}, at 2.4 GHz is –18 dB, and measured peak DC output voltage is more than 90 mV at an input power of 16 dBm. Due to the CVD graphene MMIC process, a rectifier array becomes realistic, and hence, it could be employed in low-energy devices such as wireless-sensor-network and medical implants.

References

[1] M. Shaygan et al, Nanoscale, 9 (2017) page 11944—11950
[2] M.-D. Wei et al, IEEE MWCL, 30 (2020) 1173-1176

Figures

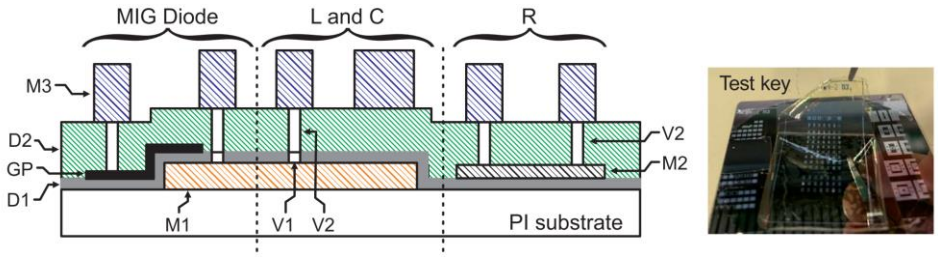
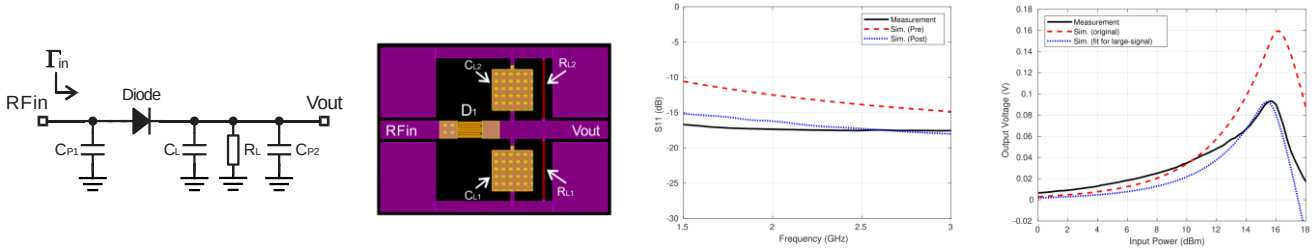


Figure 1: Cross section of the graphene MMIC process and the photograph of the testkey for modelling



(a) (b) (c) (d)

Figure 2: a) Schematic of the implemented rectifier, b) its layout, (c) simulated and measured S_{11}, and (d) rectified DC output voltage