Terahertz Rectennas on Flexible Substrates Based on One-Dimensional Metal-Insulator-Graphene Diodes

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Introduction. Diode-coupled antennas (rectennas) enable on-chip energy harvesting of terahertz (THz) radiation for low power circuits.[1] The rectenna's performance is mainly limited by the diode's responsivity and frequency response.[2] Here, we demonstrate a rectenna based on a one-dimensional (1D) metal-insulator-graphene (MIG) diode (Fig. 1a) capable of rectifying radiation up to 170 GHz in free-space measurements.[1]

Fabrication. Flexible polyimide is used as a substrate. Oxide-encapsulated single layer graphene grown by chemical vapor deposition is etched to reveal the 1D edge. A conformal TiO_2 barrier layer and a metallic contact are deposited, completing the 1D MIG junction. An ohmic edge contact is formed on the other side of the graphene channel in an analogous way, along with a metallic bowtie antenna, shown in Fig. 1b.[1,3,4]

Results. The sample was irradiated by a THz beam from 110 to 170 GHz under bias, and the DC output was measured. The optical responsivity $\gamma_{THz} = \frac{2\sqrt{2}\,\Delta V}{P_{ava}}$ (ΔV: measured rectified DC voltage, P_{ava}: available output power of the THz source) surpassed 80 V/W (Fig. 1c), with a noise equivalent power of 80 pW/√Hz, thereby outperforming comparative metal-insulator-metal rectennas.[1,2,4]

References

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[3] Wang, Z., et al., ACS Appl. Electron. Mater., 1 (2019) 945-950
[4] Shaygan, M., et al., Nanoscale, 9 (2017) 11944-11950

Figures

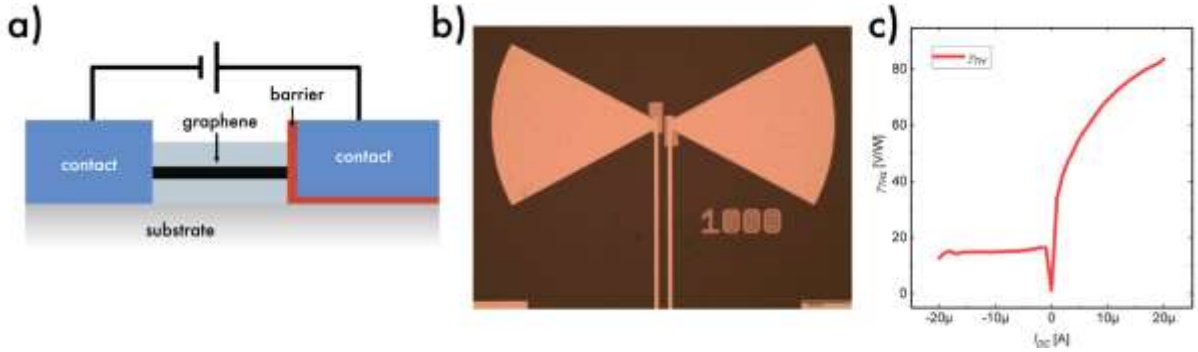

Figure 1: a) Cross-section of a 1D MIG diode. b) Micrograph of the rectenna. c) Measured responsivity.