Design of highly efficient graphene micro-ring modulator on SiN platform for on-chip communication

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Abstract

The development of electro-optic (EO) modulators is essential for the advancement of on on-chip optical signal processing [1]. While silicon-photonics is a prime candidate, graphene photonics has garnered significant attention due to its remarkable electrical and optical properties [2]. Graphene EO modulators typically uses silicon-on-insulator (SOI) platforms, but Silicon-nitride–on-silicon-dioxide (SiN-on-SiO_2) is emerging as a promising alternative with lower optical losses, broader transparency windows and CMOS compatibility. Despite potentials advantages, achieving high modulation depth as well as large modulation bandwidth simultaneously in a single graphene-based device has been challenging due to the weaker graphene-light interaction and bandwidth-efficiency trade-off [3]. To address this challenge, we propose and demonstrate a highly modulation efficient and large bandwidth double layer graphene micro-ring EO modulator integrated on a SiN waveguide platform. The proposed modulator achieves a high modulation depth of 5 dB/μm^{-1} equivalent to an extinction ratio of 27 dB with 8V driving voltages. The simulation of the designed device results in a 3-dB modulation bandwidth beyond 40 GHz by integrating only 5 µm long graphene. Due to concurrent presence of high modulation bandwidth and efficiency renders the design of such modulators are highly viable for on-chip optical communication applications.

References

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Figures

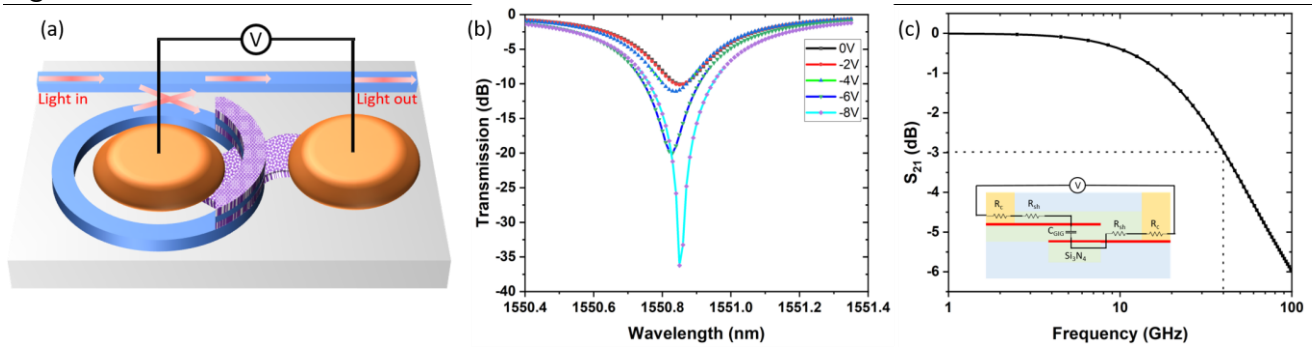

Figure 1: a) Schematic view of proposed graphene integrated micro-ring modulator b) Transmission spectra for various applied voltages on ring modulator c) Electro-optic S_{21} response

Acknowledgment

This research was funded by the European Union's Horizon 2020 research and innovation programme under Graphene Flagship grant agreement No 952792