Graphene based electro-optical modulators and phase shifters

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Abstract

Graphene is a promising material for realizing high-performance on-chip electro-optical modulators because of graphene's excellent optical properties, which are controllable by electric gates, and the possibility to integrate graphene based modulators on silicon and other dielectric waveguides.

In this talk I will discuss our recent results on graphene based absorption modulators, phase modulators and thermo-electric phase shifters [1-3]. A key issue for all these devices is the residual insertion loss added by the light absorption of graphene. This parameter is essentially depending on the mobility µ and doping level n in graphene, with higher values for both µ and n providing less absorption. In addition contaminations introduced during device fabrication play an important role on the overall insertion loss of the device. Therefore techniques for maintaining the intrinsically high carrier mobility in graphene during device fabrication and for achieving high, stable and reproducible doping levels in graphene need to be developed in order to realize competitive electro-optical modulators.

Finally, I will benchmark the current results with competing technologies and give an outlook on which performance can be expected for graphene based electro-optical modulators and phase shifters.

References

[1] Muhammad Mohsin et al. „Graphene based low insertion loss electro-absorption modulator on SOI waveguide" Scientific Reports 5, (2015) 10967.

[2] Muhammad Mohsin et al. „Experimental verification of electro-refractive phase modulation in graphene" Optics Express. 22, (2014) 15292.

[3] D. Schall et al. "Infrared transparent graphene heater for silicon photonic integrated circuits Optics Express 24, (2016) 7871.

Figures

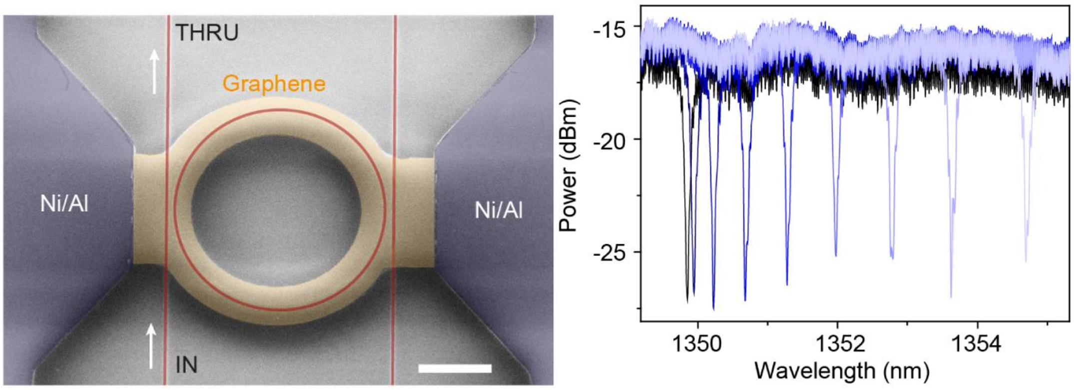

Fig. 1 Left side: False color SEM image of a silicon micro-ring resonator having a graphene based thermos-electric phase shifter on top. Right side: One optical resonance of the ring resonator for different heating power levels in the graphene based heater. With increasing heating power the resonance shifts to longer wavelengths.