Graphene Integrated Photonics for optical communications

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Abstract

Datacom and Telecom are continuously improving in terms of bandwidth, consumption and cost. The request of bandwith increase at constant consumption and cost requires increasing technology challenge. According to the Ethernet roadmap the bandwidth doubles every two years [1] and the candidate technology for large volume and low cost is Silicon Photonics [2]. With Si Photonics it is possible to realize electro-refractive modulators and Ge based detectors exceeding 56GBaud/s. However continuous improvements and technological limits may limit the scalability of the existing technologies.

Graphene offers electro-absorption [3] and electro-refraction [4] effect for modulators and switches and thermo-electric effect for the detection [5]. Graphene layers can be transferred on waveguides in the post-processing phase, the supporting waveguide has very limited requirements because no dopants are required for operating the devices. Graphene based photonics is proven by design on the base of material models verified by characterizations.[4] From theory graphene photonics can be competitive with respect to Si Photonics [5].

In this presentation recent experimental developments will show the roadmap towards graphene integrated photonics devices with very high performances. A characterization of the electrorefration effect shows an index change as large as 10^{-3} on a SI waveguide [4] overcoming the index obtainable in Si Photonics by change plasma dispersion effect. First transmission experiments on 100km of standard fiber at 1550nm carried out with graphene electroabsorption modulation at 10Gb/s showed performances comparable with well established technologies. First results of wafer scale growth and transfer on 150mm wafers with preservation of high mobility value will be shown [6]. The combination of these results indicates the potentiality of graphene photonics. However the present results require little improvements in terms of graphene quality (carrier mobility), contact resistance and efficient device structures. These aspects will be discussed and a roadmap of improvements will be shown.

References

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Figures

Figure 1: Century Gothic 10