Ultrafast graphene photonics for futuristic generation of datacoms

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Silicon Modulators
- Require large scale → sufficient modulation depth (due to a relatively weak high-order electro-optical effect).

Modulators based on Germanium and other Compounds
- Have severe problems to be integrated with current complementary metal-oxide-semiconductor (CMOS) techniques.

Modulators with Resonators
- Narrow modulation bandwidth with stringent fabrication requirement and thermal instability limits their development.

Graphene Optical Modulators

Mechanism of Absorption with Electrical Gating in Graphene

When Graphene is positively charged, fermi level is lowered ($E_F < -h\nu/2$), transmission is allowed. When $-h\nu/2 < E_F < h\nu/2$, transmission is attenuated and the incident light can excite electron. When Graphene is negatively charged ($E_F > h\nu/2$), there is no state available for the electrons to be excited. Therefore absorption in this case is zero.

Due to the coupling between the directional waveguides, light appears in all waveguides along the propagation, regardless if the input tunable light source is injected to (a) the outer or (b) the middle waveguide. (c) and (d) observation of AE configuration with a wider middle waveguide. (c) Light is coupled to an outer waveguide in an AE configuration. The preliminary results agree with simulation results (absence of light in the middle waveguide). Measurement is done at $\lambda = 1550$ nm with different waveguide’s lengths (ranging from 100-500 nm). Error bars are obtained for 3 different measurements. The transmission is normalized with fabricated single waveguide to compensate the waveguide’s loss.

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The applied voltage to graphene is enough to do the modulation.

REFERENCES