Integrated graphene plasmonic waveguide modulators

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Graphene has offered a new paradigm for extremely fast and active optoelectronic devices due to its unique electronic and optical properties [1]. With the combination of high-index dielectric waveguides/resonators, several integrated graphene-based optical modulators have already been demonstrated [2-4]. However, the optical modes in these systems are inherently strongly localized in the high-index materials, thus jeopardizing light-graphene interactions.

Surface plasmon polaritons have been shown the ability to manipulate light in the nanoscale [5], while at the same time giving possibility to direct more optical energy to the material interface where graphene could reside. We propose and demonstrate efficient graphene plasmonic waveguide electro-optical modulators, which are fully integrated with the silicon-on-insulator platform. We experimentally achieve the tunability of 0.13 dB/μm for the graphene plasmonic modulator, which exceeds the performance of previously reported graphene-plasmonic modulators and graphene-silicon waveguide modulators.

References

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[3] C.T. Phare et al., Nature Photon. 9 (2015) 511-515.
[4] Y. Ding et. al., Nano Lett., 15 (2015) 4393-4400.
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[6] Y. Ding et. al., arXiv:1610.05352

Figures

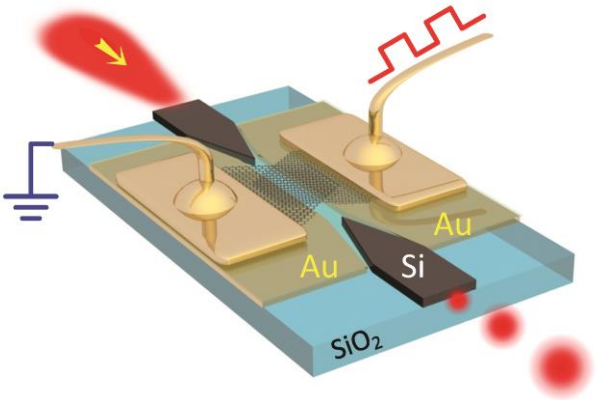

Figure 1: 3D schematic of the graphene-plasmonic waveguide modulator

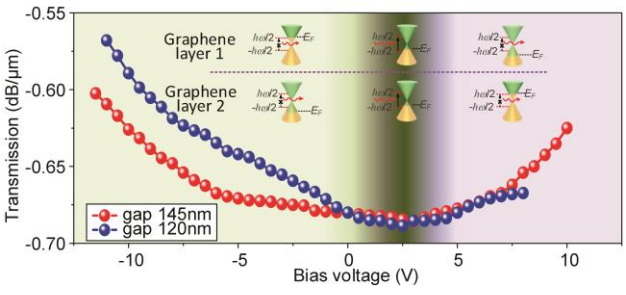

Figure 2: Modulated transmission (as a function of bias voltage) for 20 μm-long graphene-plasmonic hybrid slot waveguides.