Graphene Planar Plasmonic Waveguide Devices

Choon-Gi Choi

Creative Research Center for Graphene Electronics,
Electronics and Telecommunications Research Institute (ETRI), Daejeon, 305-700, Korea
E-mail: cgchoi@etri.re.kr

Abstract

Graphene has attracted great attention due to its extraordinary electronic, thermal, mechanical, and optical properties [1]. In photonics, graphene have been exhibited outstanding properties such as transparency, wavelength-independent optical absorption, satuable absorption, electron-hole pair generation, third-order nonlinearity, and electro-absorption. Graphene has been used as a transparent conductor for photovoltaics, light emitting diodes, and touch panels [2]. In optical data communication applications, graphene has been considered as a versatile photonic material to modulate, detect, control, and even guide light [3-5].
Recent theoretical investigations on graphene-based photonic devices exhibited that graphene embedded in a homogenous dielectric can serve as a lightwave guiding medium [6–8]. For further development of graphene based on-chip PICs, planar-lightwave-circuit (PLC)-compatible integrations of the graphene-based optoelectronic devices is being consistently demanded, thereby novel PIC platform such as plasmonic waveguide and modulator have been proposed [9-10].
In this talk, we demonstrated recent progress in graphene-based plasmonic devices such as thermo-optic mode extinction modulator and planar lightwave-type photodetector based on graphene plasmonic waveguides for all graphene photonic integrated circuits [11-12].

Acknowledgements

This work was supported by the Creative Research Program of the ETRI (13ZE1110) of Korea and by a grant (Code No. 2011-0031660) from the Center for Advanced Soft Electronics under the Global Frontier Research Program of the Ministry of Science, ICT and Future Planning of Korea.

References

[1] A. K. Geim and K. S. Novoselov, Nat. Mater. **6** (2007) 183.
[2] F. Bonaccorso, Z. Sun, T. Hasan, and A. C. Ferrari, Nat. Photon. **4**(9) (2010) 611.
[3] M. Liu, X. Yin, E. Ulin-Avila, B. Geng, T. Zentgraf, L. Ju, F. Wang, and X. Zhang, Nature **474** (2011) 64.
[4] T. Mueller, F. Xia and P. Avouris, Nat. Photon. **4**(5) (2010) 297.
[5] Q. Bao, H. Zhang, B. Wang, Z. Ni, C. H. Y. X. Lim, Y. Wang, D. Y. Tang, and K. P. Loh, Nat. Photon. **5(7)** (2011) 411.
[6] S. A. Mikhailov and K. Ziegler, Phys. Rev. Lett. **99**(1) (2007) 016803.
[7] G. W. Hanson, J. Appl. Phys. **103**(6) (2008) 064302.
[8] M. Jablan, H. Buljan, and M. Soljacic, Phys. Rev. B **80**(24) (2009) 245435.
[9] Jin Tae Kim, Jaehyeon Kim, Hongkyw Choi, Choon-Gi Choi and Sung-Yool Choi, Nanotechnology **23**(34) (2012) 344005.
[10] Jin Tae Kim and Choon-Gi Choi, Optics Express, **20**(4) (2012) 3556.
[11] Jin Tae Kim, Kwang Hyo Chung, and Choon-Gi Choi, Optics Express (2013) in revision.
[12] Jin Tae Kim, Young-Jun Yu, Hongkyw Choi, and Choon-Gi Choi, in preparation.

Figures

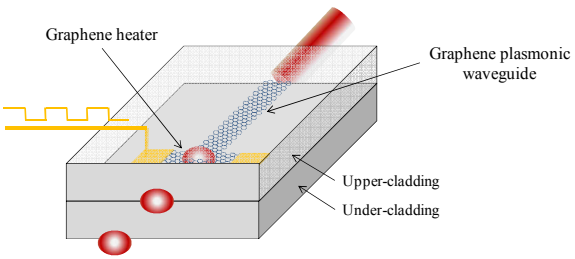

Fig. 1. (a) Schematic view of the proposed graphene-based thermo-optic mode extinction modulator.

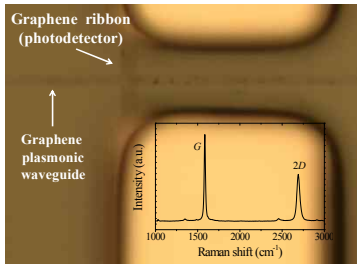

Fig. 2. Picture of the fabricated planar lightwave-type graphene photodetector. The inset shows the Raman spectrum from the graphene ribbon.