Ultracompact complex spatial light modulation pixel using plasmonic waveguides

Joonsoo Kim[1], Hwi Kim[2] and Byoungho Lee[1]
[1]National Creative Research Center for Active Plasmonics Application Systems
Inter-University Semiconductor Research Center and Electrical Engineering
Seoul National University, Gwanak-Gu Gwanakro 1, Seoul 151-744, South Korea
[2]ICT Convergence Technology for Health & Safety and Department of Electronics and Information Engineering, Korea University, 2511 Sejong-ro, Sejong 339-700, South Korea
Tel.:82-2-880-7245, E-mail: byoungho@snu.ac.kr

Spatial light modulators (SLMs) are versatile light field manipulation devices which can be used to synthesize optical fields ranging from nanoscale surface plasmon polariton fields to holographic images formed by computer generated holograms (CGHs)[1, 2]. Conventional SLMs can operate on either phase-only or amplitude-only modes, both of which are incomplete. Incomplete modulation of light causes undesirable noises including twin noises and additional filters for elimination of these noises make the system too bulky for practical uses[3]. There have been attempts to realize integrated complex spatial light modulation devices which are mostly based on macro-pixel design and some successful designs were presented theoretically and experimentally[3, 4]. However, the possibility of extreme scale-down to sub-micron pixel has not been explored much.

In this paper, we numerically investigate a reflection type complex modulation pixel (CMP) based on plasmonic waveguide structure. In Fig. 1(a), the schematic of the proposed CMP is shown. Numerical analysis shows that the amplitude and the phase of the reflected light can be controlled by adjusting L_1 and L_2 as shown in Figs. 1(b) and 1(c). Furthermore, high sensitivity near the dark point implies that the adjustment of L_1 and L_2 can be replaced by various active modulation mechanisms which have small dynamic range.

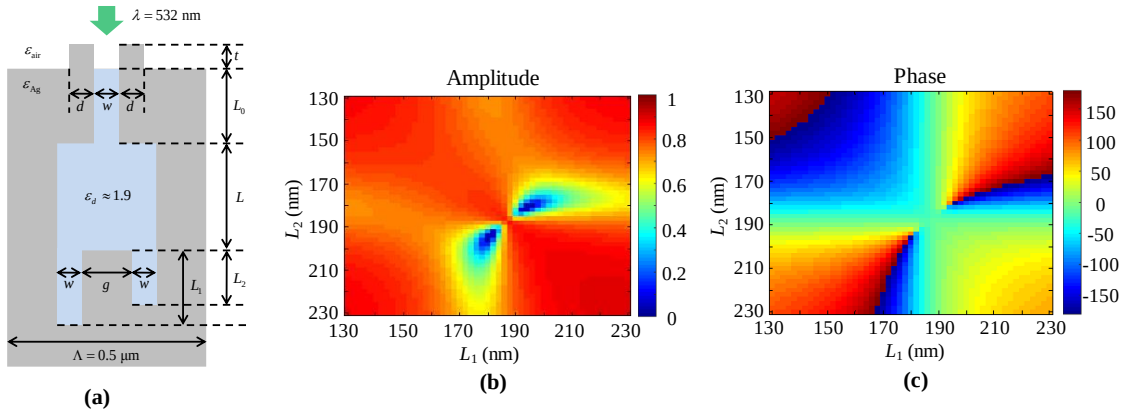

Fig. 1. (a) The schematic of the proposed complex modulation pixel. (b) Amplitude and (c) phase of the reflected light depending on the parameters L_1 and L_2

Acknowledgment

This work was supported by the Center for Advanced Meta-Materials(CAMM) funded by the Ministry of Science, ICT and Future Planning as Global Frontier Project (CAMM-2014M3A6B3063710).

References

1. H. Kim, J. Park, S.-W. Cho, S.-Y. Lee, M. Kang, and B. Lee, *Nano Lett.* **10**(2), 529 (2010).
2. W.-H. Lee, *Prog. Opt.* **16**, 119 (1978).
3. S. Choi, J. Roh, H. Hong, G. Sung, J. An, W. Seo, K. Won, J. Ungnapatanin, M. Jung, Y. Yoon, H.-S. Lee, C.-H. Oh, J. Hahn, and H. Kim, *Opt. Express* **22**(18), 21460 (2014).
4. S. Reichelt, R. Häussler, G. Fütterer, N. Leister, H. Kato, N. Usukura and Y. Kanbayashi, *Opt. Lett.* **37**(11), 1955 (2012).