Nano Scale Disruptive Silicon-Plasmonic Platform for Chip-to-Chip Interconnection

Decision on an optimized structure for plasmonic modulator with a maximum loss of 20dB

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Executive Summary

This document shall incorporate (all) rules procedures concerning the technical and administrative management of the project and is therefore to be updated on a regular basis. Please look at www.navolchi.eu regularly for the latest version.

Change Records

Version	Date	Changes	Author
0.1 (draft)	2013-06-21	Start	Argishti Melikyan
1 (submission)	2013-06-21		Argishti Melikyan

Surface plasmon polariton absorption modulator

We have studied both phase and absorption plasmonic modulators in the Deliverable D3.2. Based on the results presented there, we have decided to focus on the phase modulator, and the decision is discussed in Milestone MS9.

However, it has been experimentally shown by the group in UC Berkeley [1] that the absorption modulator employing a plasma dispersion effect in the indium tin oxide(ITO) layer in reality provides much better performance than what the models predict [2-3]. Therefore, we have decided to fabricate and test surface plasmon polariton absorption modulators in the configuration given in Fig. 1(a). Device length L_{1dB} providing 1 dB extinction ratio for 4.5 V_{pp} driving voltage as a function of insulator thickness d is given in the Fig. 1(b). In addition, the insertion loss in the device is given in red.

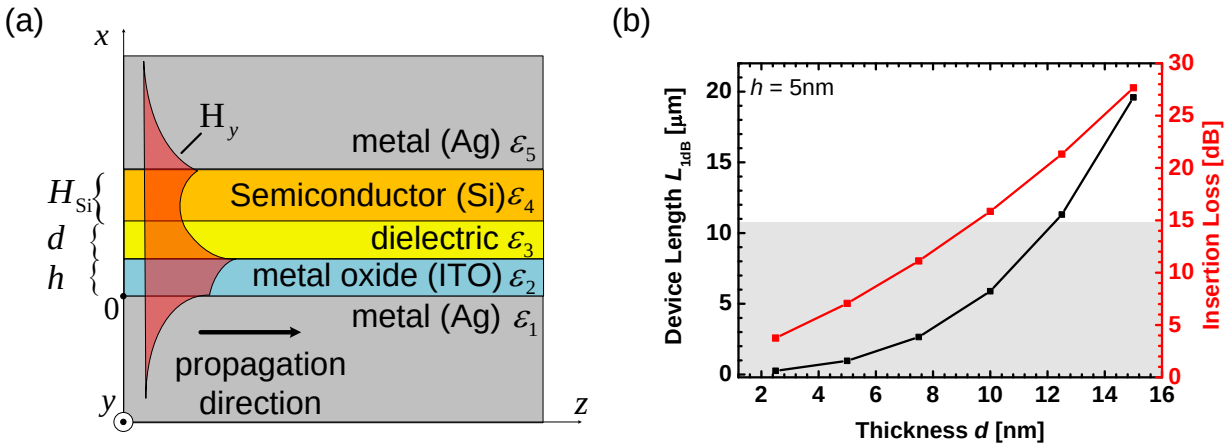

Figure 1 Surface plasmon polariton absorption modulator (SPPAM). (a) Cross section of the SPPAM, (b) device length and insertion loss as a function of insulator thickness d. H_{Si} and h are assumed to be 220nm and 5nm respectively.

In order to keep the total insertion loss of the final device below 20 dB we have decided to focus on the structure which has maximum 15 dB intrinsic losses. Additional losses are expected from photonic - plasmonic interface. The targeted values of the geometrical parameters are listed below:

Parameter name	Value
H_{Si}	220nm, 340nm
d	< 13nm
h	5nm, 7.5nm

[1] V. J. Sorger, N. D. Lanzillotti-Kimura, R.-M. Ma, and X. Zhang, "Ultra-compact silicon nanophotonic modulator with broadband response," Nanophotonics **1**, 17–22 (2012).

[2] A. Melikyan, N. Lindenmann, S. Walheim, P. M. Leufke, S. Ulrich, J. Ye, P. Vincze, H. Hahn, Th. Schimmel, C. Koos, W. Freude, and J. Leuthold, "Surface plasmon polariton absorption modulator," Opt. Express **19**, 8855-8869 (2011).

[3] A. V. Krasavin and A. V. Zayats, "Photonic Signal Processing on Electronic Scales: Electro-Optical Field-Effect Nanoplasmonic Modulator," Phys. Rev. Lett. **109**, 053901 (2012).