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

Plasmonic Active Device Characterization Results

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List of Partners concerned

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Executive Summary

This document contains the first characterization results performed on active plasmonic devices fabricated within the framework of NAVOLCHI up to month 12 of the project.

Change Records

Version	Date	Changes	Author
0.1 (draft)	2012-10-20	Start	Sascha Muehlbrandt
1 (submission)	2012-11-22	Revised structure	Sascha Muehlbrandt

Contents

Introduction

NAVOLCHI explores a plasmonic interconnect comprising several novel active plasmonic devices. These devices are

- Nano-scaled Lasers
- Modulators
- Amplifiers
- Detectors.

The scope of this document is to report about the characterization results of active plasmonic components fabricated up to month 12 of the project.

Characterization Results

As of the date this document was written (October 2012), the fabrication procedures for most of the active plasmonic devices are in development and characterization of the respective devices is not presented here.
However, first plasmonic phase modulators are completed and initial optical characterization measurements have been performed.
We have fabricated 10µm and 15µm long plasmonic phase modulators consisting of two tapered metallic couplers in both ends for SPP coupling and de-coupling. The fabrication approach is discussed in MS16 (available on NAVOLCHI web-site). We have fabricated the plasmonic phase modulator on silicon on insulator chips designed by KIT and fabricated by IMEC. Diffraction grating couplers designed by IMEC have been used for light coupling into the silicon nano-wire with 480nm width. Light is collected in the end of the silicon nanowire with the help of lensed fiber, see Fig. 1.

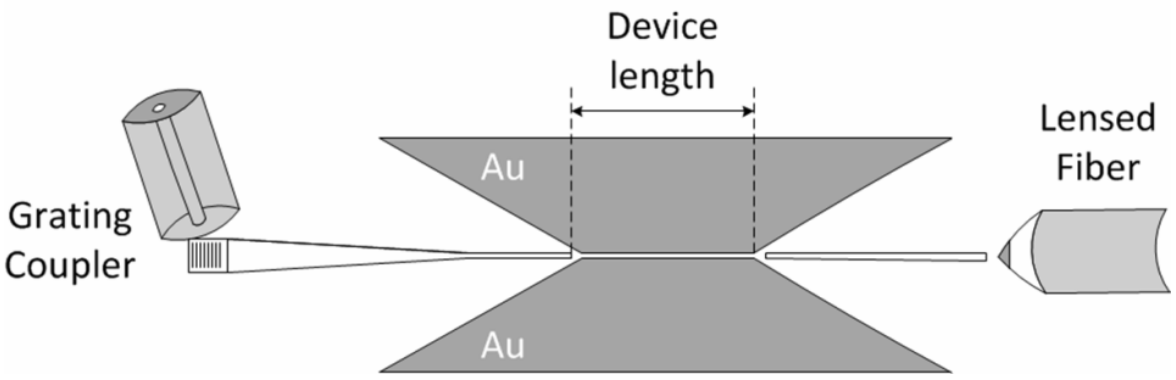

Figure 1: The configuration of the setup used for optical characterization. The diffraction grating couplers have been used for coupling light into the silicon waveguide. Light is collected at the other end of the silicon waveguide with lensed fiber.

Below we show the transmission spectra of the 10µm long modulator with 167nm metallic slot width, see Milestone 16. Insertion loss of 12dB has been measured for 10µm long device. Referring to the Milestone 16, we can estimate that the propagation loss of the metallic slot with 167nm width is 0.8dB/µm -1dB/µm instead of 0.42dB /µm theoretical value. The project goal is fabrication of plasmonic modulators with less than 20dB loss. Comparing this value to our measurements, we see that the device matches the requirements of the project NAVOLCHI.

The finite length of the silicon nanowire of ~1mm results in Fabry-Perot fringes in the transmission spectrum with ~82GHz free spectral range as it can be seen in the spectrum given below.

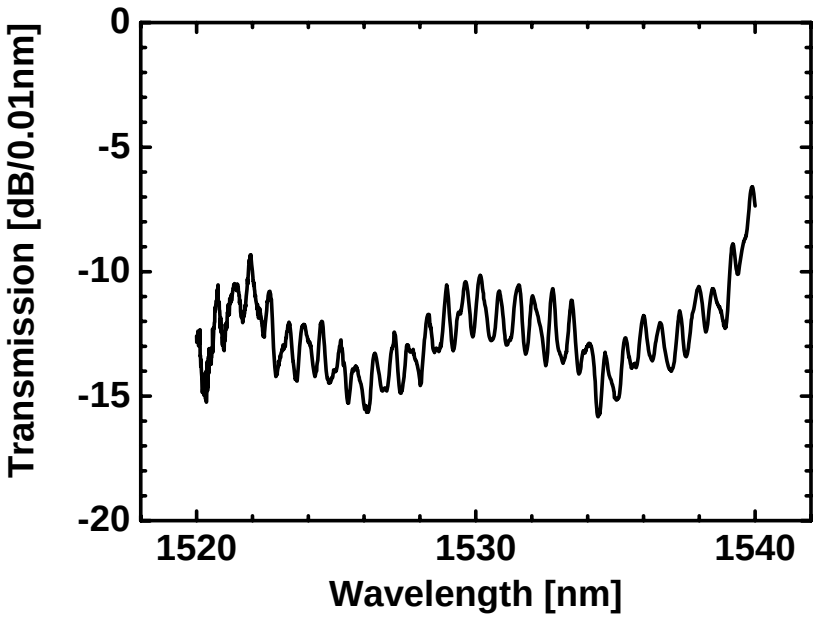

Figure 2 Transmission spectrum of the 10μm long device with 167nm wide metallic slot.

Future Work and Outlook

As discussed before, the active plasmonic devices in NAVOLCHI are currently fabricated and characterization results will be available after fabrication is achieved.
For each of the devices currently in fabrication, separate milestones exist that will cover the characterization of the respective devices:

- For the modulator, a full characterization will be available in MS14, July 2013.
- The nano-laser will be characterized in MS15, October 2013.
- The detector will be characterized in MS23, October 2013.
- The amplifier will be characterized in MS24 April 2014
- A full characterization will be given in MS40: “Individual plasmonic devices characterization, testing and evaluation” and D6.1: “Report on characterization results of all plasmonic devices”.