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Design of an Ultra-compact Silicon Plasmonic Modulator for Optical Interconnections

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Abstract

This work aims to design a CMOS compatible, low-electrical power consumption modulator assisted by plasmons. For compactness and reduction of the electrical power consumption, electro-absorption based on the Franz-Keldysh effect in germanium was chosen for modulation. It consists in the change of the absorption coefficient of the material near the band edge under the application of a static electric field, hence producing a direct modulation of the light intensity. The use of plasmons allows enhancing the electro-optical effect due to the high field confinement. An integrated electro-optical simulation tool was developed to design and optimize the modulator. The designed plasmonic modulator has an extinction ratio of 3.3 dB with insertion losses of 11.2 dB and electrical power consumption as low as 20 fJ/bit, i.e. the lowest electrical power consumption reported for silicon photonic modulators. In- and out-coupling to a standard silicon waveguide was also engineered by the means of an optimized Si-Ge taper, reducing the coupling losses to only 1 dB per coupler. Besides, an experimental work was carried out to shift the Franz-Keldysh effect, which is maximum at 1650 nm, to lower wavelength close to 1550 nm for telecommunication applications.

The speaker

Nicolás Abadía was born in Buenos Aires, Argentina in 1986. He received a double degree Master of Science in Photonics from the Royal Institute of Technology, Ghent University and Free University of Brussels in 2011. His master thesis was on non-linear effects in silicon ring resonators. He also received an engineering degree in electronics from the Technical University of Madrid and the Royal Institute of Technology in 2009. He is now working towards a PhD degree at Paris-Sud 11 University and CEA-Leti. His activities are related to design of ultra-compact plasmonic modulator for optical interconnections in Silicon Photonics.