

Soutenance de Thèse

Mardi 4 octobre 2016 à 14h 00

Centre scientifique d'Orsay – bât 220 - salle P. Grivet Rdc pièce 44

Perez-Galacho Diego - Photonique

**High speed optical modulation, advanced modulation formats and
mode division multiplexing in Silicon photonics**

Membres du jury :

Mme. Christelle AUPETIT-BERTHELEMOT	Université de Limoges	Rapporteur
M. Yannick DUMEIGE	Université de Rennes I	Rapporteur
M. Charles BAUDOT	STMicroelectronics	Examineur
M. Frédéric GARDES	University of Southampton	Examineur
M. Didier ERASME	Télécom ParisTech	Examineur
M. Alejandro ORTEGA MOÑUX	Universidad de Málaga	Invité
Mme. Delphine MARRIS-MORINI	Université Paris-Sud	Directrice de thèse

Résumé :

Bandwidth demand in optical communication systems is continually growing. Data rate values in the order of several hundreds of TBps are expected in the near future. In order to cope with those expectations silicon based technologies are believed to be the best suited. Its naturally compatibility with CMOS easily enables the electronics and photonics co-integration. In the short-term the way increase data rates in next generation optical communication systems goes through using advanced modulation format and increase symbol rates. In the long-term view, new multiplexing techniques will be required. In this sense, mode division multiplexing is nowadays an attractive approach under consideration.

In this Thesis work, the way to implement these new optical communication schemes is studied from the transmitter point of view. It includes, on the one hand, the modeling, design and characterization of silicon modulators. And in the other hand, it includes the proposition, design and characterization of novel mode handling devices for mode division multiplexing.

A new way of modeling silicon modulators has been developed. This new model permits to reduce the computation time of modulator analysis up to two orders of magnitude, while maintaining a good level of accuracy. Using the model, modulators based on lateral PN junctions and interdigitated PN junctions were designed to work in the O-Band of optical communications. Characterization work has been performed on these modulators with good results. Wide-open OOK eye diagrams were obtained at 10GBps. Furthermore, BPSK modulation was also demonstrated at 10GBps.

New kind of mode converters and multiplexers, intended to work as mode division multiplexing subsystems have been proposed, designed, fabricated and characterized. Measured results show broad bandwidth operation high extinction ratio.

Mots clés : modulation, optics, silicon, mode division multiplexing, mode division multiplexing.
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