

PhD position on high-speed photodiode and switch fabric integration on advanced integrated circuits for ultra-low power optical I/O

Ghent University – imec, Photonics Research Group
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Job context:

Silicon photonics is a field that is maturing and attracting strong interest from industry and academia to realize miniaturized photonic systems for applications in datacommunication and telecommunication, as well as in other emerging fields, such as sensing. For the field of datacommunication, there is a need for ultra-low power consumption, high bitrate transceivers. Most approaches today involve the use of silicon photonics transceivers, integrating the modulators and the photodetectors, but keeping laser sources external. Due to the relatively high insertion loss of the modulators and limited sensitivity of the receivers, the power consumption of such solutions is about 5pJ/bit. In this project we want to dramatically reduce the power consumption of these optical transceivers by a factor of 20 using a new paradigm and realize such transceivers using advanced heterogeneous integration technology. The Photonics Research Group, an associated lab of imec, is at the forefront of the research in this area.

Job description:

As a PhD researcher, you will work in the framework of the UGent GOA project “Photonic network-on-wafer for multi-tile GPUs: from architecture to hardware implementation”. This project involves all relevant groups at UGent working on GPUs, networking, high-speed electronics and photonics. The goal of the project (~ 10 PhD projects in total) is to demonstrate a prototype of an optical network-on-chip that interconnects different GPUs using ultra-low power optical links.

In order to realize such ultra-low-power links the sensitivity of the receiver is of paramount importance. In this project we want to drastically improve this receiver sensitivity by integrating the photodiodes on the high-speed electronics, implemented in a 16nm FinFET CMOS process. This will substantially reduce the (parasitic) capacitance of the device and interconnect and hence enhance the receiver sensitivity. As one can imagine, such an optical interconnection between GPUs will have a tremendous amount of I/Os. This implies that a technique needs to be used to -in a high-throughput fashion- integrate such photodiodes on the 16nm FinFET circuit. This optical receiver will then be flip-chip integrated on a SiN waveguide circuit in which the optical network is implemented. The Photonics Research Group is at the forefront of heterogeneous integration technologies that allows the high-throughput, high-precision integration of III-V opto-electronic components on photonic integrated circuits, and is especially focusing on an integration approach called micro-transfer printing.

The goal of this project is to design, fabricate and micro-transfer print high-speed photodiodes on 16nm FinFET CMOS transimpedance amplifier circuits. Next to this, for complex networks-on-chip, optical switch fabrics will be needed. Also these devices will be designed, fabricated and micro-transfer printed on the SiN waveguide circuit. You will interface with another PhD student in the project that will develop the transimpedance amplifier electronics (and also the drivers for the transmitters). Another PhD student will

be responsible for the integration of the optical transmitters and optical amplifiers on the same circuit, leading to a compelling demonstrator at the end of the project. We believe big players in the area (NVIDIA, intel, Google...) would very much welcome such an approach for next-generation optical interconnects for e.g. GPUs, CPUs and TPUs.

Profile

You are an ambitious, passionate and talented student. You have recently obtained a master degree in Photonics, Optical communication or Electrical engineering. You have a good understanding of photonic integrated circuit technology and optical networks. You possess good verbal and written English communication skills allowing you to effectively communicate with the academic partners.

As an equal opportunity employer, UGent encourages women to pursue careers in science and strongly welcomes female candidates.

Our offer

In exchange for your talent, passion and expertise, you will get an interesting position in a multicultural and high-tech institute, with challenges for the taking. This is your opportunity to contribute to the technology that will determine the society of tomorrow. We offer a position of 4 year in the Photonics Research Group, imec's associated lab at Ghent University.

Application

Please submit your expression of interest with resume and motivation letter by no later than June 1st 2021 by applying online through the following link:

<http://photonics.intec.ugent.be/contact/vacancies/Application.htm>

For further information, please contact

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Photonics Research Group

www.photonics.intec.ugent.be

About the Photonics Research Group

The Photonics Research Group (about 85 people) is associated with imec and is part of the Department of Information Technology of Ghent University. The group is headed by Prof. R. Baets and has been active in photonics device research for many years. The other professors in the group are P. Bienstman, W. Bogaerts, S. Clemmen, B. Kuyken, N. Le Thomas, G. Morthier, G. Roelkens and D. Van Thourhout. The main research directions are silicon photonics, heterogeneous integration, optical communication, sensing and computing.

