Advanced Silicon Photonics Platform for High Performance Computing Applications

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Abstract

Within the IRT Nanoelec program, LETI, Mentor Graphics, ST Microelectronics, ALMAE Technologies and the French public research body, CNRS, have developed a full silicon photonics platform highly suitable for High Performance Computing applications. The core process comprises passive and active silicon devices such as ring modulators and high speed photodetectors and is completed by plug-in modules to allow advanced circuit design: an additional Silicon Nitride wave guiding layer for complex optical routing, integration of Through Silicon Vias on the photonic wafer for high IO density packaging and finally, a III-V on silicon toolbox allowing designers to integrate laser sources directly within the photonic chip. A full suite of computer assisted circuit design and layout tool is also available in the Tanner L-edit software allowing further design automation using Mentor Graphics most recent tools (automatic optical and electrical routing and Layout vs. Schematics functionality). In this presentation, a review of the main device performance is given, with a focus on recent reduction of the silicon wave guiding loss using plasma annealing, leading for instance to less than 0.25dB/cm for rib waveguides. Finally, application circuit examples are described, specifically illustrating reasonable targets in terms of thermal management of the devices, use of optical switching, on-chip bandwidth density and circuit scalability.

Benoît Charbonnier received his engineering degree in 1994 from Ecole Nationale Supérieure des Télécommunications de Paris and received his Ph.D. degree in 1997 on 40Gbps soliton transmission from the same institution. In 1997, he joined Nortel Network in Harlow, UK, in the Advanced Communications group where he worked on 80Gbps long haul transmission and then, in 2001, joined Marconi Communications to develop an Ultra-Long Haul 10Gbps based transmission product. In 2004, he moved to Orange labs as a research engineer, focusing on next generation optical access networks and particularly on digital signal processing applied to optical communications. In 2015, he joined CEA, in Grenoble, leading the photonics program within the French Institute of Technology Nanoelec, developing industrial partnerships to promote Silicon Photonics Technologies.