2017 PhD Thesis on

Thermo-mechanical assessment of TSV keep out zone in Si-photonics optical devices

Funding : CIFRE
Partners: ST Microelectronics Crolles, CEA Leti, IM2NP (Aix Marseille Univ & CNRS).

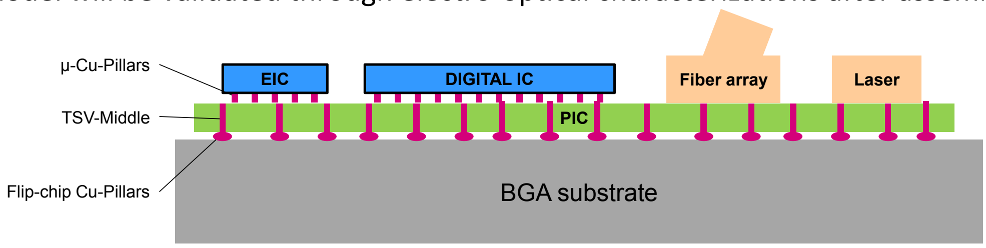
In order to address bandwith improvement to 400 Gb/s, wire-bonding has to be replaced by flip-chip using TSV (through silicon via), thus leading to 3D partitioning that will offer reduced power consumption, wider bandwidth and faster transmission speed, while providing better system flexibility. TSV technology integration is required to enable the stacking of ASIC on Si-Photonics interposer to reach the bandwidth and energy saving specifications of next product generation (2020).

The objective of this work will be to participate to the integration of copper filled TSV in Si-photonics platform and to investigate the effect of TSV induced strain on optical components such as waveguides, photo-diodes, and modulators. The quantification of the stresses in photonic Si is vital for the optimization of design and for the development of reliable 3D stacked structures.

TSV is known to generate strain in silicon due to coefficient of thermal expansion (CTE) mismatch between Cu and Si, leading to Keep Out Zone (KOZ) design rules for transistors. However interactions with optical components remain unknown. Thus the thermo-mechanical mechanisms and their interactions with optical devices will be modeled in order to propose optical predictive models and KOZ design rules.

The PhD student task will be to define and integrate 3D test structures including TSV-Middle and optical elements in collaboration with Si-Photonics design team. Advanced characterizations (μ-Raman, nano-diffraction at synchrotron) will be carried out to extract strain maps in optical components around TSV.

The results will enable the calibration of thermo-mechanical simulations using a Finite Elements Analysis (FEA) software, in order to propose a predictive model for optical KOZ design rules. This model will be validated through electro-optical characterizations after assembly.



For further information, please contact
Olivier Thomas (Olivier.Thomas@im2np.fr, Tel.: +33 (0)4 91 28 86 72) or
Stéphanie Escoubas (Stephanie.escoubas@im2np.fr, Tel.: +33 (0)4 91 28 80 95)

Applications including a CV and a letter of motivation should be sent to Olivier.Thomas@im2np.fr
Deadline: June 20th, 2017

Institut Matériaux Microélectronique Nanosciences de Provence
UMR CNRS 7334, Universités d'Aix-Marseille et de Toulon

Faculté des Sciences St Jérôme, 13397 Marseille cedex 20