

(Chaire CRSNG-IBM) Innovative strain sensors on microelectronic chips

Record number : OPR-524

Overview

RESEARCH DIRECTOR

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Information

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ADMINISTRATIVE UNIT(S)

Faculty of Engineering
Department of Electrical and Computer
Engineering
Interdisciplinary Institute for Technological
Innovation

LEVEL(S)

Ph.D.

LOCATION(S)

3IT - Institut interdisciplinaire d'innovation
technologique

Project Description

Context: In the field of high-performance computing, the heterogeneous integration of several specialized electronic chips on a single multichip module (MCM) enables the performance of electronic devices to be increased while diversifying their functionalities. In order to meet the ever-increasing needs of high-performance applications (e.g. cloud computing, supercomputers, high-speed communications), the computing power of MCMs is continually increasing, and with it the amount of heat to be dissipated. In this context, thermomechanical stress induce shear deformations that can cause delamination problems at chip interconnects. It would therefore be desirable to be able to precisely measure the distribution of thermomechanical strains at the level of the chip solder balls inside the MCM. This would help optimize the design and increase reliability to prevent premature and irreversible failures. It would also allow IBM's simulation tools to be improved using experimental data that were previously inaccessible. We therefore propose a thesis project aimed at developing innovative micrometric strain sensors directly integrated in the back-end-of-line (BEOL) of the chips around the solder balls.

Research project: This PhD project will focus on the exploration and study of new approaches for the realization of strain micro-sensors directly integrated in the BEOL of microelectronic chips. Based on the processes and expertise of the research group of Prof. Dominique Drouin in the fields of micro-fabrication and advanced packaging, the student will have to (i) design strain sensors to be integrated in the form of a matrix on silicon. Emerging materials such as carbon nanotubes, graphene or molybdenum disulfide (MoS₂) will be considered, (ii) develop and implement the complete process of micro-fabrication of the sensors in clean room as well as their morphological characterization, (iii) develop a test bench and protocols to measure deformations in test chips induced by controlled mechanical and/or thermal loads, (iv) perform strain measurements of chips assembled on organic substrates according to industry standards, (v) improve the thermomechanical simulation models already existing at IBM thanks to the experimental data collected.

Work environment: This project will be carried out under the co-supervision of Prof. Dominique Drouin (UdeS) and Prof. H  l  ne Fr  mont (IMS Bordeaux, France) as part of the IBM/CRSNG Industrial Research Chair on Heterogeneous Integration for High Performance Computing. The student will also collaborate with Prof. Yann Beilliard and the team of engineers at IBM Canada (Bromont). The work will be done at the Interdisciplinary Institute for Technological Innovation (3IT) at Universit   de Sherbrooke, and at the MiQro Innovation Collaborative Center (C2MI) in Bromont. 3IT is a unique institute in Canada, specializing in the research and development of innovative technologies for energy, electronics, robotics and health. C2MI is an international center for collaboration and innovation in the MEMS and packaging fields. It is the essential link between applied research and the microelectronics industry. The candidate will thus benefit from an exceptional research environment combining students, professionals, professors and industrialists working hand-in-hand to develop the technologies of the

future.

Researched profile:

- Specialization in nanotechnology and advanced packaging
- Strong adaptability, autonomy and teamwork
- Strong taste for design, experimental cleanroom work, research and development
- Strengths: In-depth knowledge of microfabrication technologies and strain sensors

Contact:

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Documents to provide: CV, transcripts of the last 2 years, motivation and recommendation letters

Discipline(s) by sector

Funding offered

Partner(s)

Natural Sciences and Engineering

Yes

IBM Canada Ltée.

\$ 21 000

Electrical Engineering and Electronic Engineering

The last update was on 11 January 2021. The University reserves the right to modify its projects without notice.