UNIVERSITÉ DE SHERBROOKE

(Chaire CRSNG-IBM) High-density interconnects for high performance computing and artificial intelligence

Record number : OPR-571

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
C2MI - Centre de Collaboration MiQro Innovation

Project Description

Context: In the field of high-performance computing (HPC), the heterogeneous integration of electronic chips on a single low-cost organic substrate allows to increase the computing power of the modules while diversifying their functionalities. This implies that the density of metal lines on the substrate interconnecting the different chips (e.g. processors and memories) must continuously increase in order to ensure the bandwidth required by demanding applications such as computing servers and artificial intelligence. However, the current processes used for the fabrication of organic substrates face technical limitations slowing down the miniaturization of metallic interconnects. A promising alternative is to first reconstruct a wafer by molding multiple chips in a polymer, and then fabricate the different levels of metal interconnects using organic dielectrics directly on top of the molded chips. These wafers can then be prepared with under bump metallization and solder balls to be diced and assembled in a multi-chip microelectronic module. We thus propose a PhD project dedicated to the fabrication and study of high-density metallic interconnections on large size chips molded in a polymer for HPC and artificial intelligence applications.

Research project: This PhD project deals with the development of molding processes for large electronic chips and the fabrication of very high-density interconnections between several molded chips, presenting as main challenges the reproducibility and reliability of the obtained structures. Based on the processes and expertise of the research group of Prof. Dominique Drouin's research group at 3IT and C2MI in the field of microfabrication, the student will be in charge of (i) reviewing the literature on molding methods and interconnections of molded chips, (ii) developing molding processes of chips in a polymer using industrial grade equipment, (iii) designing electrical test structures for interconnections based on organic dielectrics (iv) develop the complete microfabrication process of the interconnects, including dielectric layer deposition, direct write lithography, metal thin film deposition and plasma etching steps using state-of-the-art microfabrication equipment; (v) perform complete morphological and electrical characterization of the samples to determine the fabrication quality and performance of the interconnects. Functionality validations after the interconnection of 2 molded chips will be targeted; (vi) study the environmental reliability and the resistance to electromigration and thermomechanical stresses of the realized interconnections.

Supervision & work environment: This PhD thesis will be realized under the co-direction of Prof. Dominique Drouin and Prof. Yann Beilliard,

as part of the IBM/CRSNG Industrial Research Chair on High Performance Heterogeneous Microelectronic Integration. The work will be done mainly at the Interdisciplinary Institute for Technological Innovation (3IT) at the Université 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 encapsulation field. It is the essential link between applied research and the marketing of microelectronics products. The student will thus benefit from an exceptional research environment that combines students, professionals, professors and industrialists working hand-in-hand to develop the technologies of the future.

Profile:
• Master’s degree, specialization in micro-nanotechnology or materials science
• Strong adaptability, autonomy and teamwork
• Strong taste for design, experimental cleanroom work, research and development
• Strengths: experience in microfab in clean room and knowledge in advanced packaging

Documents to provide: CV, cover and recommendation letters and transcripts for the past two years.

Discipline(s) by sector

Natural Sciences and Engineering

Electrical Engineering and Electronic Engineering

Funding offered

Yes

$ 21 000

Partner(s)

IBM Bromont

The last update was on 29 April 2021. The University reserves the right to modify its projects without notice.