UNIVERSITÉ DE SHERBROOKE

(Chaire CRSNG-IBM) Study of the self-assembly of electronic chips assisted by the surface tension of solder balls

Record number : OPR-562

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 the same organic substrate makes it possible to increase the computing power of the modules while diversifying their functionalities. This implies that the density of the metal lines on the substrate interconnecting the different chips (i.e. processors and memories) must constantly increase to ensure the bandwidth required by future HPC applications. In this context, the silicon bridge technology (Si-bridge) precisely integrated into the organic substrate is an interesting approach, taking advantage of mature silicon microfabrication technologies for the realization of local high-density interconnections. This overcomes the interconnect density limitation encountered by organic substrate fabrication techniques at a much lower cost than the interposer technology with through silicon vias (TSV). However, one of the main challenges with Si-bridge is its assembly on the organic substrate, which must be fast, robust and micrometer accurate. We are therefore proposing a thesis project aimed at studying surface tension-assisted self-assembly methods using solder microbumps for the precise and fast positioning of Si-bridge. This innovation would allow the large-scale assembly of microchips with a microbump pitch of 30 µm.

Research project: This thesis project focuses on the development and characterization of innovative methods for the self-assembly of Si-bridge chips on advanced organic substrates. Based on the processes and expertise of the research group of Prof. Dominique Drouin at 3IT in the fields of micro-fabrication on silicon and advanced packaging, the student will be in charge of (i) designing high-precision self-assembly methods assisted by the surface tension of solder microbumps. The use of microstructures on silicon and organic substrates will also be studied; (ii) developing the complete clean room micro-fabrication process of self-assembly structures on Si-bridge and organic substrates. This work includes the design of photolithography masks; (iii) developing a test bench and protocols for measuring the alignment accuracy and tilt of the Si-bridge with respect to the substrate; (iv) performing the assembly of electrical test chips on the organic substrate including the Si-bridge; (v) performing the complete characterization of the assembly, including measuring the misalignment (x, y, z, θ) between the different chips, the thermomechanical robustness and the electrical continuity between the different chips interconnected via the Si-bridge; (vi) performing mechanical/microfluidic simulations in order to optimize the design of the alignment structures.

Supervision & work environment: The thesis will be carried out under the co-supervision of Prof. Dominique Drouin and Prof. Yann Beilliard,

within the framework of the IBM/CRSNG Industrial Research Chair on High Performance Heterogeneous Microelectronic Integration. The work will be carried out mainly at the Institut Interdisciplinaire d'Innovation Technologique (3IT) of the Université de Sherbrooke and at the Centre de Collaboration MiQro Innovation (C2MI) in Bromont. The 3IT is a unique institute in Canada, specialized in research and development of innovative technologies for energy, electronics, robotics and health. The C2MI is an international centre for collaboration and innovation in the MEMS and encapsulation sector. It is the essential link between applied research and the commercialization of microelectronics products. Students 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 micro-nanotechnology, applied physics or materials science
• Strong adaptability, autonomy and teamwork
• Strong taste for design, experimental cleanroom work, research and development
• Strengths: knowledge of micro-nanofabrication, fluid mechanics, assembly packaging of electronic chips

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 March 2021. The University reserves the right to modify its projects without notice.