UNIVERSITÉ DE SHERBROOKE

(Chaire CRSNG-IBM) Study of plasma etching processes of metallic thin films for the microfabrication of high-density interconnections

Record number : OPR-472

Overview

RESEARCH DIRECTOR

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ADMINISTRATIVE UNIT(S)

Faculty of Engineering
Department of Electrical and Computer Engineering

LEVEL(S)

Ph.D.

LOCATION(S)

3IT - Institut interdisciplinaire d'innovation technologique

Project Description

Context: In the field of high-performance computing (supercomputing, server farms, cloud computing, etc.), the heterogeneous integration of electronic chips on the same organic substrate makes it possible to increase the computing power of microelectronic modules while diversifying their functionalities. At the same time, the dimensions of the vertical interconnections (copper pillars) on the surface of silicon chips are constantly decreasing to increase their number of inputs/outputs. This means that the dimensions of the metal lines on the organic substrates connecting the different chips (e.g., processors and memory chips) must also decrease in order to provide the bandwidth required for next-generation applications. It is thus estimated that metal interconnect lines will soon need to reach sub-micron dimensions in terms of line width and spacing (L/S). However, standard microfabrication methods on organic substrates based on the semi-additive approach do not allow interconnections of less than 2 µm L/S to be achieved. It is therefore desirable to develop innovative microfabrication methods that can extend this limit while reducing the complexity and cost of the processes used. This is why we propose, in the framework of the Industrial Research Chair with IBM Canada, a thesis project aiming at developing and studying plasma etching processes of metallic thin films in order to realize low-cost and high-density interconnections on organic substrates.

Research project: This thesis project focuses on the development and study of plasma etching processes of different metal thin films used as interconnections in microelectronic modules, such as copper and titanium. Drawing on the expertise of Prof. Dominique Drouin's group in the fields of microfabrication and advanced microelectronics encapsulation, the student will be in charge of (i) carrying out a complete literature review of the different plasma etching processes of metallic thin films; (ii) designing etching and electrical test structures and associated photolithography masks; (iii) developing clean room processes for etching metallic thin films. The etching mechanisms will have to be studied and optimized in order to control the etching rate, the selectivity between the different substrate materials, the quality of the etching flanks and the surface roughness of the metal; (iv) performing complete physico-chemical and morphological characterizations to account for the composition and the final integrity of the materials on the substrate; (v) fabricating interconnections using the developed etching process and characterizing their electrical performance and reliability; (vi) developing models accounting for the etching mechanisms for different metals.

Supervision & work environment: The work will be carried out under the co-supervision of Prof. Dominique Drouin and Prof. Maxime Darnon, as part of the IBM/NSERC Industrial Research Chair in High Performance Microelectronic Heterogeneous Integration. Prof. Yann Beilliard will also act as a mentor. 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 sector. 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.

Researched profile:
• Specialization in micro-nanofabrication or materials science
• Strong adaptability, autonomy and teamwork
• Strong taste for design, experimental cleanroom work, research and development
• Strengths: knowledge in plasma physics and advanced packaging technologies

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 Canada Ltée.

The last update was on 24 November 2020. The University reserves the right to modify its projects without notice.