Copper deposition by MOCVD for high form factor through silicon vias for 3D integration.

Sabrina FADLOUN

Supervisors: Elisabeth Blanquet et Thierry Mourier (CEA-Léti)

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Amphitheater Jean Besson (Phelma-Campus)

Jury :
Mr Stéphane DANIELE, Professeur des Universités Lyon 1, Rapporteur.
Mr Thomas DUGUET, Chargé de Recherche, CNRS, Toulouse, Rapporteur.
Mme Brigitte CAUSSAT, Professeur des Universités, ENSIACET, Toulouse, Examinatrice.
Mr Michel PONS, Directeur de recherche CNRS, Grenoble, Examinateur.

Abstract: Innovations from the semiconductor world are evolving towards multiple applications and are present in many industrial sectors, medical, or biotechnology. Their deployment was achieved thanks to an increase in the performance of integrated circuits (speed, energy consumption), but also thanks to a multidisciplinary approach based on the integration of heterogeneous functions made possible by an evolution of interconnections and the emergence of TSV: Through-Silicon Vias. Their micronic dimensions require metallization adapted to copper deposition, in particular by a so-called "seed layer" which acts as a conductive film necessary to initiate the electrolytic deposition reaction for filling the TSVs, ensuring the routing of the electrical signal over the entire chip. It is in this context that chemical deposition and in particular MOCVD (Metal-Organic Chemical Vapor Deposition) is becoming a high-potential candidate for metal coatings with complex geometries. The main determinants of this deposition technique are the reactor design and the molecular structure of the chosen organometallic precursor. We studied the properties of bis(dimethylamino-2-propoxy)copper(II), marketed as Cu(dmap)2, as well as the influence of dihydrogen and water during the copper deposition reaction. We have integrated this pure, continuous, compliant, low-stress metallic copper film into TSVs with a 10:1 form factor. Cavity-free electrolytic filling reveals interesting properties of the Cu(dmap)2 molecule for this type of application.