Editorial
Preface to the Special Section on Electromigration Published in March 2009

IN THE MARCH 2009 issue of IEEE TRANSACTIONS ON DEVICE AND MATERIALS RELIABILITY, we published a Special Section containing papers on the topic of electromigration in Cu interconnects. At the time of publication, we could not include a preface to the Special Section. This issue contains the preface to provide a background to the meeting where the papers were originally presented and the significance of the material contained in the papers.

The Workshop on Electromigration Reliability was organized as a companion workshop (workshop www.sispad.org/sispad/sispad-events/sispad-2007/companion-workshops.html) of the International Conference on Simulation of Semiconductor Processes and Devices (www.sispad.org) which was hosted in 2007 in Vienna, Austria, by the Institute for Microelectronics of TU Wien. The goal of the workshop was to present a profound review and the newest expertise on electromigration by invited talks of leading researchers.

Electromigration is a complex multiphysics problem including electrical, thermal, and mechanical aspects, with a strong dependence on the microstructure of the interconnect metal. Metal grain boundaries are fast diffusivity paths and have a significant influence on the electromigration behavior. The choice of surrounding layers, e.g., barrier and capping layer, has also a huge impact on the electromigration behavior. The atomic structure of the interfacial region can enhance or suppress electromigration. Design and material choice determine the mechanical stress distribution as well as the thermal household of an interconnect layout. Mechanical stress is an additional driving force for material transport and is also a source of electromigration anisotropy. The interconnect process technology determines the properties of the metal microstructure and can also introduce defects dramatically accelerating electromigration degradation.

The speakers at the workshop were Joseph J. Clement (Sandia National Laboratories, U.S.), Jeff Gambino (IBM, U.S.), Chee Lip Gan (Nanyang Technological University, Singapore), Alexander von Glasow (Infineon, Germany), Jim R. Lloyd (IBM, U.S.), Valeriy Sukharev (Ponte Solutions, U.S.), Carl V. Thompson (Massachusetts Institute of Technology, U.S.), King-Ning Tu (University of California at Los Angeles, U.S.), Ehrenfried Zschech (AMD, Germany), and Hajdin Ceric (Institute for Microelectronics, TU Wien, Austria).

Three speakers decided to contribute papers to this Special Section on electromigration reliability. These papers are an excellent representation of the main topics addressed and discussed during the workshop.

The first paper, entitled "Geometry and Microstructure Effect on EM-induced Copper Interconnect Degradation" by E. Zschech, P. S. Ho, D. Schmeisser, M. A. Meyer, A. V. Vairagar, G. Schneider, M. Hausschield, M. Kraatz, and V. Sukharev, deals with a statistical analysis of the electromigration lifetimes of copper interconnects. A careful investigation of results obtained by several state-of-the-art experimental techniques reveals the main weaknesses of modern interconnect technology.

The paper "Microstructure Effect on EM-induced Degradations in Dual-Inlaid Copper Interconnects" by V. Sukharev, A. Kteyan, E. Zschech, and W. D. Nix presents a novel physical model and the corresponding simulation procedure to predict electromigration-induced stress development in copper interconnects. The model encompasses the effect of grain boundaries and the effect of texture variations.

The third paper, entitled "A Comprehensive TCAD Approach for Assessing Electromigration Reliability of Modern Interconnects" by H. Ceric, R. L. de Orio, J. Cervenka, and S. Selberherr, introduces a model for the stress-induced anisotropy of electromigration and a model for stress buildup at the adhesion weak points in copper interconnects. The physical soundness of the new models is assessed by the three-dimensional simulation of a typical dual-damascene interconnect with microstructure.

The organiziers of the Workshop on Electromigration Reliability want to thank all the speakers and especially those who have contributed papers to this Special Section on electromigration reliability.

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