Stress Evolution Due to EM in Metal Line Confined: Model and Correlation with Experiments

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Abstract

Electromigration induced failure is one of the main reliability issues for the microelectronics industry. The continuous scaling of the interconnect dimensions leads to higher operating current densities and temperatures, which accentuates the electromigration failure. As a consequence, electromigration still poses challenges for the development of the new technological nodes. Electromigration modeling become an important tool for explaining several experimental observations and can provide a stronger basis for design and fabrication of reliable metalization. The main challenge is the diversity of the relevant physical phenomena to take into account. Indeed, the material transport is driven by the vacancy concentration, mechanical stress and temperature gradients, and electrical potential. The degradation of the electrical resistance of interconnect segment can be derived from the evolution of vacancy's concentration and stress. In addition, it is shown a methodology to predict initial degradation time and position in a simple copper interconnection using a multiphysics model developed with COMSOL.

Reference

F. Cacho, V. Fiori et al., Electromigration induced failure mechanism: multiphysics model and correlation with experiments, IEEE-EuroSimE, pp. 1-6. (2008)

K. Croes, M. Lofrano et al., Study of void formation kinetics in Cu interconnects using local sense structures, Proc. of IEEE-IRPS , p 321-327. (2011)

G. Marti, L. Arnaud et al., Study of EM void nucleation and mechanic relaxation effects. Microelectronics Reliability, 54(9), 1692-1696. (2014)