Englisches Abstract Stahlmecke_Diss

Electromigration is the current induced mass transport in metallic wires. It is the main reason for electrical breakdown in integrated circuits and has been studied for more than 50 years.

In this thesis, the electromigration behavior in polycrystalline gold as well as in self-organized single crystalline silver wires are studied. To study the electromigration behavior in detail, *in-situ* investigations of the wires are performed in a scanning electron microscope, for which a new test rig was successfully installed.

During electromigration, the development of voids on the cathode and hillocks on the anode side of the wire are observed. This behavior is studied in detail in this thesis. Electrical breakdown in the gold wires takes place due to the presence of slit-like voids perpendicular to the current direction. The void area grows linearly during the course of the experiments, and the electrical breakdown takes place when the total void area reaches a value of 2 % to 4 % of the total wire area. The influence of *single* voids on the electrical resistance during high current stressing is determined.

The dependence of the electromigration behavior on the width and height as well as on the crystallinity and temperature of the gold wires is studied in detail. For high resolution imaging of the wires during the experiments, a special layout with arbitrary kinks is used. The dependence of electromigration effects on current density and on the influence of the measurement setup itself are also discussed in this thesis.

When reversing the current direction, a reversible electromigration behavior is observed. Also, the lifetime of the wires grows considerably. According to the resistance data, a remarkable stabilization of the polycrystalline wires is observed during this experiments. Furthermore, it is possible to define an alternative Blech length according to the position of voids and hillocks in the wires. This leads also to the determination of the critical product for these gold wires, which agrees well with data from literature on other metallic systems.

For the first time, it is possible to study electromigration within self-organized single crystalline silver wires. Surprisingly, the electromigration behavior is completely different from that observed for polycrystalline gold wires. Electrical breakdown takes place at the anode side of the wire, i. e. material transport takes place against the direction of the electrons. These results indicate, that the direct force might be the dominating force within this system.