CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

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Project Number

S1810

Project Title

Kinetic Monte Carlo Simulation on Atomic Diffusion on a Cu-Sn Surface

Abstract

Objectives/Goals

Under applied electric current, interconnects in integrated circuits are known to fail when lack of resistance to electromigration causes directional diffusion and the formation of voids as a consequence. The goal of this project is to study the influence of alloyed Sn atoms on resistance of Cu to electromigration by focusing on the migration paths of a single Cu atom (adatom) as it moves along the surface.

Methods/Materials

We model the diffusion of an adatom on the Cu (111) surface in the presence of Sn impurities using a computational simulation. The Sn impurities deform the potential energy surface and create obstacles that block the adatom migration. The Kinetic Monte Carlo method (KMC) is employed as a randomization technique to generate the migration paths of the adatom.

Results

The results confirm that the Sn impurities create areas to which the adatom cannot migrate and that these areas change in size with temperature.

Conclusions/Discussion

Since the Sn impurities significantly affect the potential migration paths of the adatom, it can be concluded that the Sn impurities would increase resistance of copper to electromigration. This supports a future improvement of interconnects by coating them with a Cu-Sn alloy surface, therefore allowing the material to last longer under applied electric current. A stronger interconnect would also allow for the production of smaller integrated circuits.

Summary Statement

Studying a Cu-Sn alloy surface's effect on the physical property of copper's resistance to electromigration.

Help Received

Parents edited report; Dr. Cheng, Dr. Po, and Professor Ghoniem supervised and mentored me in the building of my computational simulation; Mr. Starodub guided me in the research formalities.