Nanoscale Deposition of Electroless Alloy Films to Prevent Cu Diffusion and Migration

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INTRODUCTION

This paper describes fundamental aspects and applications of various electroless processes for the deposition of nanometer thin films of a number of composite alloys applied to copper surfaces. Sequential, selective, mechanisms for the surface activation of substrates of nanometer dimmensions will be discussed as well as the electrochemical deposition reactions involved. The paper will focus on film structures involving ternary and quaternary alloys of the type Me-X-Y and Me-X-Y-Z, where Me is the primary metal in the alloys, X is phosphorous or boron, Y is an alloy modifier consisting of W, Sn or Si and Z is either Pd or gold.

RESULTS

Compositional analysis of the electroless deposited alloys by RBS will be reported, also the effect of the films on copper resistivity, and AEX profiles to show the effect of the film coating in preventing diffusion of copper accross the film barrier, after annealing the structures at high temperature. One of the purposes and specific properties of these electroless layers is to increase the interfasial adhesion between the copper surface and dielectric films. Detailed evaluation of the enhanced interfasial adhesion due to the innerlayer alloy, as well as quantitative adhesion data and interpretation will be given. Furthermore, the mechanisms of the various electroless processes will be presented based on voltammetric studies and mixed potential measurements.

CONCLUSIONS

The significance of the improved surface modification by the application of these electroles alloys layers are: 1) Enhanced structure stability against corrosion, significant decrease in the diffusion and migration of copper atoms, and increased electronic reliability.