Dynamic Scaling in Electroless Cu Deposition

Nasser Mahmoud Hasan*
Jonathan Mallett
Walther Schwarzacher
Sebastião Gomes dos Santos Filho*

Universidade de São Paulo
EPUSP/PEE/LSI
Av. Prof. Luciano Gualberto, 158 – Trav.3
Cidade Universitária
São Paulo- SP-Brasil
CEP 05508-900

University of Bristol
H.H.Wills Physics Laboratory
Tyndall Avenue
Bristol BS8 1TL

Electroless deposition is a widely used thin film growth process, by which it is possible to deposit metal electrochemically without the use of an external current source. Cu has gained much attention as a new interconnect material replacing Al in ULSI metallization. In this work, we study the kinetic roughening of electroless Cu, deposited from solutions containing formaldehyde as the reducing agent, $CuSO_4$ as the source of Cu, EDTA as complexing agent, 2,2`-dipyridyl as stabilizer and KOH to adjust the pH. Sputtered Al/Au/Ti on Si substrates were used and Cu films of different thickness were produced by varying the deposition time. The electroless Cu surfaces were studied by ex-situ atomic force microscopy (AFM). From the AFM analyses, we found that electroless Cu surfaces show anomalous scaling, whereby the interface width scales as $t^{\beta loc}$. l^H, where l is the length scale over which the roughness is measured, H is the Hurst exponent, t is the time of deposition and β_{loc} is the local roughness exponent. The influence of the formaldehyde concentration and pH on the scaling properties of the electroless Cu has been studied, and will be compared with results from electrolytic Cu films.