

Effect of Gravitational Level on the Initial Stage of Cu Electrodeposition

Hirofumi INARI, Takao WAKATSUKI, Youko KONISHI, Yasuhiro FUKUNAKA¹ and Richard C. ALKIRE²

¹ Graduate School of Energy Science, Kyoto University, Yoshida Hon-machi, Sakyo-ku, Kyoto, Japan
fukunaka@energy.kyoto-u.ac.jp

² Department of Chemical and Biomolecular Engineering and National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign, Urbana, Illinois, USA
r-alkire@uiuc.edu

Abstract

Copper was electrodeposited potentiostatically in 0.05 M CuSO₄ - 0.05 M H₂SO₄ aqueous solutions onto a TaN film sputtered on a silicon substrate. Two different electrolytic cell configurations were designed in order to discuss quantitatively the effect of gravitational level on the nucleation and growth of metal electrodeposition in detail: (a) a horizontal cathode surface facing downward over an anode (C/A) and (b) an anode over cathode (A/C). FE-SEM image demonstrates the progressive nucleation model on TaN substrate. A/C configuration introduces more number of nuclei than the case of C/A at a constant applied potential. Moreover, the comparison of nearest-neighbor distance distribution among precipitated particles with Poisson random distribution confirms the existence of "exclusion zone". The growth rate of the exclusion zone is surely influenced by the gravitational level. Then, the potentiostatic electrodeposition was engaged in A/C configuration inside a centrifugal field. The nucleus number density becomes slightly increased with increasing the gravitational level. It is saturated above 100 G.