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Nanoscale wiring by Cu electrodeposition in supercritical CO_2 emulsified electrolyte with continuous-flow reaction system

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Copper wiring into nanoscale holes with high aspect ratio by electrodeposition is an important problem for 3-D integration in integrated circuit technology toward miniaturization of electronic devices. However, void and pinhole found in Cu wiring for the integration can cause trouble for miniature device. Cu electroplating method without void and pinhole is needed. We have proposed novel electroplating methods with supercritical carbon dioxide (sc-CO_2) emulsion (EP-SCE). The electrochemical reaction is carried out in an emulsion of sc-CO_2 in electrolyte with surfactants. Sc-CO_2 has low viscosity and compatibility of hydrogen. Thus, this method is applicable in fine Cu wiring. The aim of this report is to examine Cu electrodeposition by using sc-CO_2 emulsified electrolyte into nano-scale Cu wiring on the viewpoints of dissolution of Cu seed layer, gap-filling capability into nano-scale holes and contamination in the plated Cu. Moreover a continuous-flow reaction system is proposed and examined for filling of Cu into holes with 60 nm in diameter and aspect ratio of 2 and 5 by EP-SCE on a round-type large-area hole test element group with diameter of 300 mm, which has an integrated structure of Cu seed layer on TiN barrier layer sputtered on Si substrates.

Biography

Masato Sone has completed his Doctor degree of Engineering at Tokyo Institute of Technology. He has worked as a Researcher in Nippon Oil Company from 1996 to 2000. He was an Assistant Professor and then a Research Associate Professor at Tokyo University of Agriculture & Technology from 2000 to 2005, and became an Associate Professor at Tokyo Institute of Technology in 2005 and working till date. He has published more than 127 papers in scientific journals and 18 books. His majorities are microelectronics, surface finishing, chemical engineering, liquid crystal and polymer science. His recent research topic has been "Novel Nano Wiring Process Using Supercritical Carbon Dioxide for Integrated Circuit Technology".

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