

# Tertiary Current Distributions on the Wafer in a Plating Cell

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## Abstract

The reciprocating paddle cell is a known practical method for depositing alloy films on wafer substrates. Recently, the mass transfer boundary layer within an industrial wafer plating cell was studied based on the measurement of limiting current [1]. It was indicated that a shear-plate fluid agitation mechanism is capable of generating a thin (i.e., 10  $\mu\text{m}$ ), spatially uniform and nonperiodic boundary layer across the entire wafer. Since the current density on the wafer surface controls the deposited film distribution, the acquirement of tertiary current distributions would be a key to govern the quality of the deposited film when the mass transfer becomes important. The investigations of the tertiary current distributions in rotating electrodes (RDE) [2] and rotating cylinder Hull (RCH) cells [3] have been reported. However, the distribution of the tertiary current density in an industrial plating cell, especially for the case with a shear-plate fluid agitation, is still not clear. In this work, the study of the tertiary current distribution in a plating cell is presented. In this work, we used the Electrodeposition Module in COMSOL Multiphysics 4.3, for which the Single-Phase Flow Laminar Interface is applied for the shear-plate agitated fluid flows. The copper electrodeposition from an acid sulfate electrolyte is considered in this work. The simulation results include the current, potential and concentration distributions in a plating cell. The distribution of tertiary current density is calculated on the basis of the simulation of the shear-plate agitated fluid flow. The  $\text{Cu}^{2+}$  mass transfer is solved for the different shear-plate agitation frequencies. The difference between the secondary and tertiary current distributions is analyzed based on  $\text{Cu}^{2+}$  mass transfer. It is found that the controlling of the agitated fluid flow could govern the tertiary current distribution on the surface of wafer. The investigation of the tertiary current distributions on the wafer in an industrial plating cell is performed for the first time by using COMSOL Multiphysics 4.3. The calculation of the tertiary current distribution is strongly coupled with the simulation of fluid dynamics. Results show that the shear-plate fluid agitation is very useful to obtain a more uniform current distribution.

## Reference

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3. Low, C.T.J., Roberts, E.P.L., and Walsh F.C.: *Electrochim. Acta* 52 (2007) 3831.