An Electrochemical Cell with Improved Flow for Uniform Current Distribution and Plating Thickness

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In the manufacture of printed circuit boards (PCBs), electroplating is the standard fabrication technique for metallization of z-axis interconnects (or z-interconnects).[1] Use of z-interconnects facilitates vertical electrical connections, eliminating the need for long in-plane interconnects. This in turn enables higher density feature packing and results in smaller and lighter electronic products. However, uneven localized current distribution results in thin barrel plating or voiding in the fill of the z-interconnect. Traditionally, this has been addressed through use of additive chemistry, pulse plating, use of low current densities, surface overplate and in extreme instances reorientation of the panel during the plating process.

Faraday Technology's patented cell geometry[2,3,4] (shown schematically in Figure 1) provides a uniform boundary layer thickness to dampen uneven localized current distributions and promote consequent plating uniformity for full size PCB panels. The cell utilizes novel eductor placement coupled with flow channels to promote uniform solution delivery to the workpiece surface. In addition the novel flow mechanism, the cell has lateral oscillation, vibration and insulating shields to further improve uniformity of aggressive PCB features.

The cell has been extensively characterized in terms of thickness distribution as a function of cell components, shielding dimensions and substrate dimensions. The boundary layer of the cell has been experimentally calculated revealing a uniform boundary layer across an 18 x 24 inch flat substrate. Further, the cell has been validated through the deposition of varying PCB feature dimensions, indicating the cell is an ample tool in the fabrication of PCBs. Finally, the cell has been compared to other plating cell geometries in terms of thickness distribution, tensile strength and feature metallization.

Faraday has developed a number of processing cells based on this patented design for electroplating of various metals including copper, trivalent chromium and platinum as well as electroetching of copper for interlayer circuit board applications. The current work outlines the importance of various cell components and resulting uniformity. Metallization and characterization data will be presented and discussed. Scaling issues will also be addressed.

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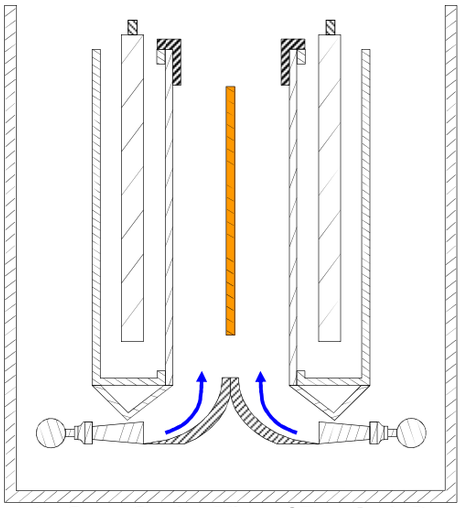

Figure 1: Cross-Section View of Faraday's Patented Electrochemical Cell.

References:

[1] P. Dixit, J. Miao and R. Preisser, Electrochem Solid State Lett, 9 (10), G305 (2006).
[2] L.E. Gebhart, J.J. Sun, P.O. Miller, and E.J. Taylor, US Patent 7,553,401 (6-3-09).
[3] L.E. Gebhart and E.J. Taylor, US Patent 7,947,161 (5-24-11).
[4] L.E. Gebhart and E.J. Taylor, US Patent 8,226,804 (7-24-12).