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MODELING AND SIMULATION: INFLUENCE OF CONVECTION ON THE CREATION OF CONDUCTING LINES AND ON VIA FILLING PROCESSES

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In general, one cannot expect an uniform velocity field of the solvent in the vicinity of a single conducting line. Furthermore, corresponding to the printed circuits boards (PCB's) design, the conducting lines are partially arranged in bundles representing a system of flow channels thus giving rise to a complex velocity field. Evidently, the velocity field is sensitively influenced by a through hole or a blind via, too. As a consequence, a realistic modeling strategy for the creation of conducting lines and for via filling processes has to involve the influence of convection .

The special simulation software [1] used in this contribution is based on a mathematical model describing the influences of diffusion, migration and convection on the movement of all the ions in dilute electrolyte solutions (transport equation). In the framework of this model (dilute ion solution model), the velocity field of the solvent is not affected by the ionic concentrations, which allows for an independent treatment of the hydrodynamic and electrochemical problem, respectively (or, in other words: the Navier-Stokes equation and the transport equation for the flux density are decoupled equations).

In order to treat the hydrodynamic problem, one has to find a numerical solution for the Navier-Stokes equation, what is a relatively difficult and time-consuming task, especially in the case of turbulent flow conditions. Fig. 1 shows an example for such a numerical solution demonstrating the influence of a one-sided flow coming from the left-hand side on the velocity field in the vicinity of a conducting line (simplified by a rectangle micro-structure). It can be seen, that a closed loop developes only at the conditions in the production of PCB's.

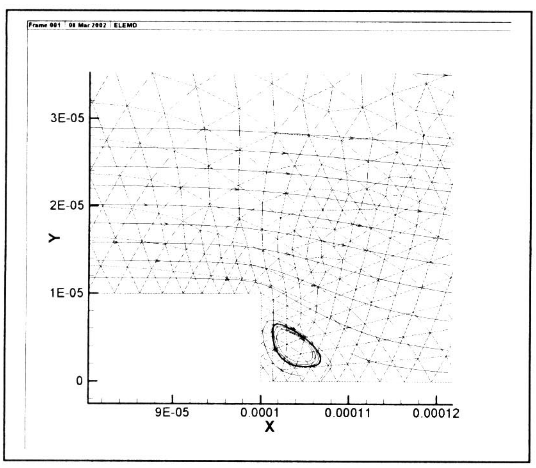

Fig. 1.: Velocity field in the vicinity of a rectangle micro-structure (width: 120μm, hight: 10μm); electrolyte flow coming from the left-hand side.

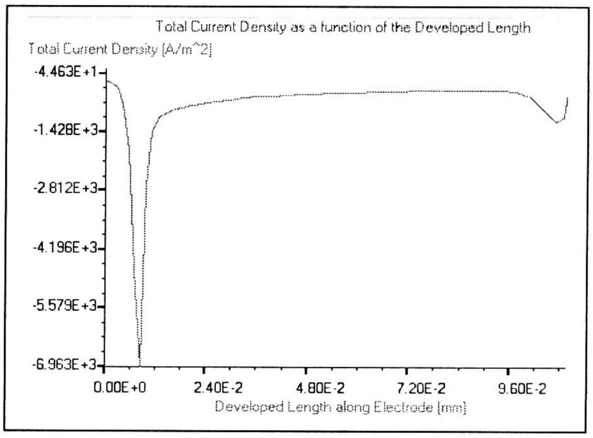

Fig. 2.: Spatial current density along the surface of the micro-structure as defined in Fig. 1 (copper deposition).

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[1] MIoTraS (see, www.elsca.com)