MODELING OF PULSE PLATING PROCEDURES USED IN THE PRODUCTION OF PCB's: CREATION OF CONDUCTING LINES AND VIA FILLING PROCESSES

B. Mollay, J. O. Besenhard, G. Fafilek, H. Kronberger, G. E. Nauer*

ECHEM Center of Competence in Applied Electrochemistry
A-2700 Wr. Neustadt, Victor Kaplanstr. 2
e-mail: gerhard.nauer@univie.ac.at

The creation of conducting lines on structured electrode surfaces by galvanostatic deposition processes has to fulfill some special requirements: The final deposit shape should be, on the one hand, roundly convex shaped, and, on the other hand, free of side broadening effects. As the authors demonstrated earlier [1] by modeling a hypothetical electrochemical system with an arbitrarily chosen polarization curve, the desired deposit shape can be achieved by using *reverse* pulse plating techniques. Since only some cycles of a combination of cathodic and anodic pulses have been treated in this earlier contribution, a modified simulation software [2] is introduced which allows for the evaluation of a higher number of pulse sequences. Therefore, the *final* shape of the deposit is accessible as a function of the pulse parameters (pulse length, pulse height, reverse pulse length/height, etc.) , thus offering a possibility of a fast optimization procedure of the pulse parameters with respect to the requirements of a technical process (a corresponding experimental optimization procedure would require a long time and great experimental effort).

Another important topic in the production of, e.g., multi layer printed circuit boards (PCB's) is the problem of filling blind vias and/or through holes. In this case, the requirement for a technical process are given (i) by a uniform layer thickness within the hole, and, (ii), by a minimal growth of the deposit outside of the hole. It will be demonstrated that - similarly to the creation of conducting lines - *reverse* pulse plating techniques again represent a powerful tool for directing the via filling process toward the desired requirements. Figs. 1 and 2 are intended to show that these requirements are *not* fulfilled in the case of a classical DC deposition procedure (Fig. 1 demonstrates the concave shape and pronounced side-broadening of a layer deposited on a photolithographically structured surface; Fig. 2 illustrates the inhomogeneous layer thickness within a hole and the enormous growth of the deposit outside of the hole produced during a filling process in a typical plating arrangement).

In continuation to [1], the modeling technique is applied to real systems by introducing the experimental polarization curves into the simulation software. The polarization curves are accessible from rotating disk experiments, which have been performed for the technical important $CuSO_4/H_2SO_4$ system, and, furthermore, used to optimize the parameters of bipolar pulse sequences for some processes important in the production of PCB's (creation of conducting lines, via filling procedures).

The simulation software used in the framework of this contribution is based on the so-called potential model, which represents a relatively crude simplification neclecting the influences of convection and mass transfer. First attempts for a more sophisticated modeling of pulse plating processes have been performed by the authors, too. Especially, the influence of convection is discussed in another contribution [3].

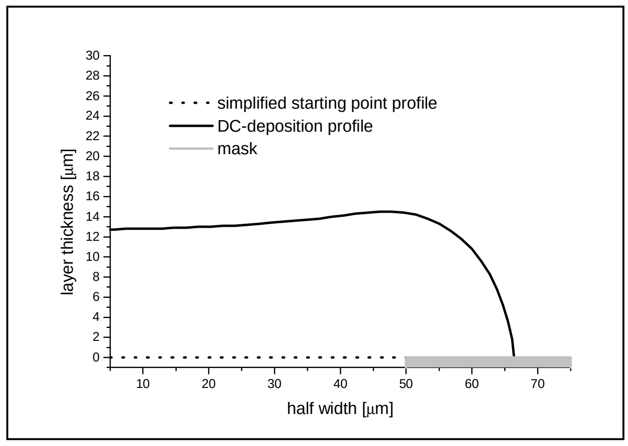

Fig. 1. Calculated shape of a conducting line deposited by a DC-current plating procedure on a photolithographically structured surface (width of the mask 100µm).

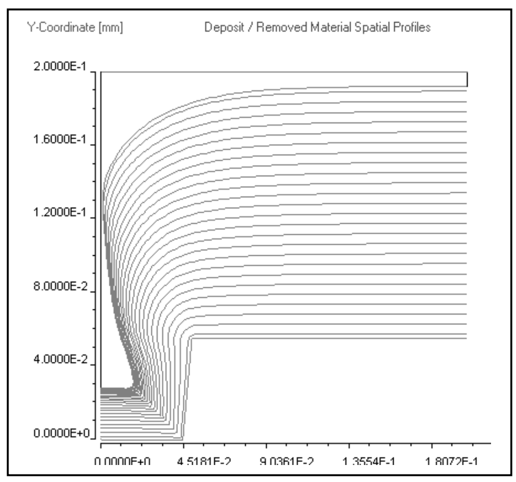

Fig. 2. Calculated deposit profiles occuring during the filling of a blind via with trapezoidal cross-section by a DC-current plating procedure (geometry of the hole: diameters: 90 µm, 100 µm; hight: 55 µm).

ACKNOWLEDGEMENT:
This work is supported by the K*plus* program of the Austrian Government and the Government of Lower Austria.

[1] B.Mollay et al. : Simulation and Modeling: Generation of structured surfaces using pulse plating; ECS's 201st Meeting, Philadelphia, May 12-17, 2002; submitted to the proceedings.
[2] ElSy (see, www.elsca.com)
[3] B.Mollay et al.: Modeling and Simulation : Influence of convection on the creation of conducting lines and on via filling processes ; this Abstracts volume.