electrochemical intelligence

Elsyca IntelliTool
Industrial validation

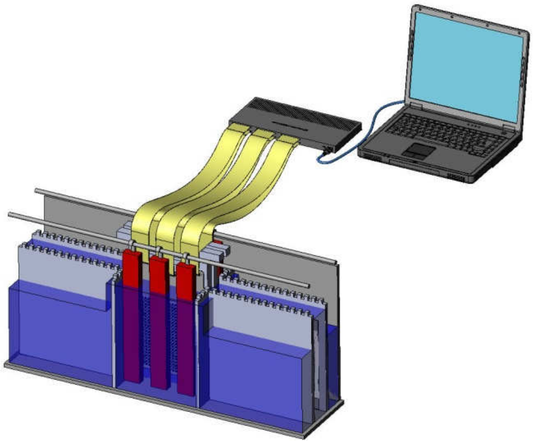
Introduction

The production of PCB (Printed Circuit Boards) consists of different steps like e.g. the drilling of the holes in the panel. Most technology issues have been taken care of in a fully automatic/integrated way, except for one major area, the galvanic copper plating

The pattern and seed layer dependence of the deposited layer thickness on PCBs or semiconductor wafers have pushed the plating process requirements over the limits of the installed plating infrastructure.

Elsyca IntelliTool

Elsyca has developed and patented a dynamically software controlled electroplating tooling concept (Elsyca IntelliTool) that allows to plate more complex and changing patterns faster and more uniform. The main change from a standard cell is the introduction of a controllable matrix of inert anode rods, at a short distance of the substrate. A figure is shown below..



The proposed technology consists of:

1. An anode holder positioned inside the electrolyte on which the anode rods are mounted. The electronic components which control the current for each individual anode are mounted on the back side of each anode, inside the anode holder.
2. The feeding network (outside of the electrolyte) consisting of a DC power supply and a USB interface to the computer to control and impose the required current on each anode segment.
3. A simulation software tool that optimises the current on each anode segment in time to yield the desired (uniform) deposition over the substrate. These simulations are based on the Elsyca technology and take all relevant effects like cell design, pattern on the substrate, and resistivity of the substrate into account. These simulations are performed off-line, prior to the actual plating process.

Gert Nelissen, Research & Technical Development Manager at Elsyca states “As the current on each of the anode segments is individually controlled and changed in time, any desired pattern can be imposed.”

This means that based on simulations, the current on each of the anode segments is determined to yield a very uniform deposition, almost regardless of the pattern and/or resistivity of the substrate. As the current on each anode segment can also be varied over time, the plating process is designed to take the change in resistivity of the conducting layer on the substrate as more metal is deposited into account. This means that even for very resistive seed/barrier layers like the ones encountered in microelectronics, the process will still yield uniform deposition.

Industrial validation

A first industrial machine implementing the Elsyca IntelliTool approach has been installed at Eurocircuits Baesweiler (Germany) http://www.eurocircuits.com. The aim is to improve the uniformity and/or deposition speed of copper electrodeposition on printed circuit boards.

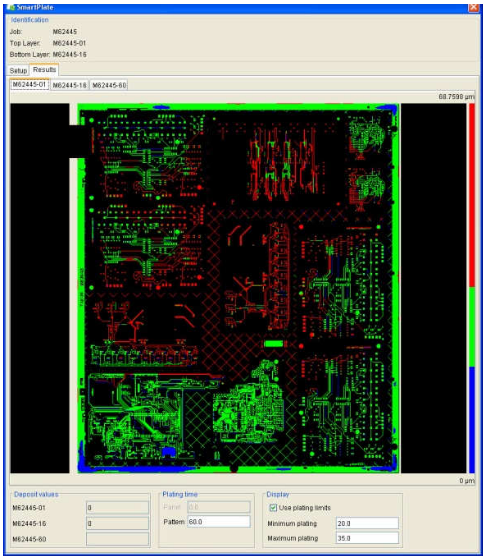
A dedicated software module has been developed to optimize the imposed current on each anode segment to yield maximum uniformity. The optimisation algorithm takes the design of the machine, the position and dimensions of the anode segments, the chemistry and polarization of the electrolyte and the pattern on the panel into account. Based on a finite element model the current on all anode segments is determined and used to predict the plating thickness distribution over the printed circuit board.

Simulations have been performed to determine the improvements of the Elsyca IntelliTool approach compared to the traditional plating process. Below is a comparison of the plating thickness distribution over an industrial printed circuit board (front and back side) plated in a traditional vertical plating configuration and with the new Elsyca IntelliTool approach.

- The same current on each side of the panel and the same plating time is used for both approaches.
- The only difference is the configuration: a main anode system in the traditional plating cell as opposed to a segmented controlled anode system in the Elsyca IntelliTool case.
- The green areas indicate plating within specs of 20 to 35 micron.
- The blue areas indicate plating thickness below 20 micron, the read areas show plating thickness above 35 micron.

Front side:

Traditional plating approach



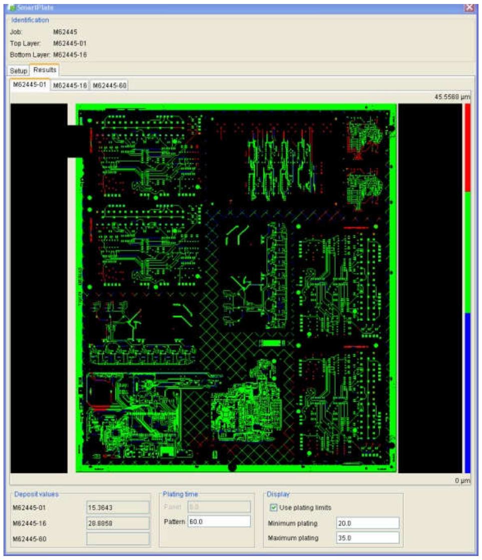
Identification
Job: M62445
Top Layer: M62445-01
Bottom Layer: M62445-16

Deposit values
M62445-01 0
M62445-16 0
M62445-60

Plating time
Panel 0.0
Pattern 60.0

Display
☑ Use plating limits
Minimum plating 20.0
Maximum plating 35.0

Elsyca IntelliTool approach



Identification
Job: M62445
Top Layer: M62445-01
Bottom Layer: M62445-16

Deposit values
M62445-01 15.3643
M62445-16 28.8858
M62445-60

Plating time
Panel 0.0
Pattern 60.0

Display
☑ Use plating limits
Minimum plating 20.0
Maximum plating 35.0

Back side:

Traditional plating approach

Identification
Job: M62445
Top Layer: M62445-01
Bottom Layer: M62445-16

Deposit values
M62445-01 0
M62445-16 0
M62445-60

Plating time
Panel 0.0
Pattern 60.0

Display
☑ Use plating limits
Minimum plating 20.0
Maximum plating 35.0

Elsyca IntelliTool approach

Identification
Job: M62445
Top Layer: M62445-01
Bottom Layer: M62445-16

Deposit values
M62445-01 20.3666
M62445-16 24.3724
M62445-60

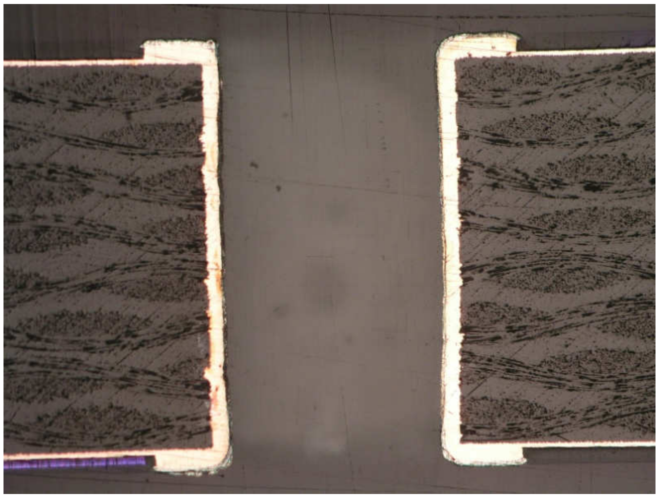
Plating time
Panel 0.0
Pattern 60.0

Display
☑ Use plating limits
Minimum plating 20.0
Maximum plating 35.0

A validation and quantification of these results on the actual panels is found on http://www.eurocircuits.com/index.php/component/content/article/120-matrix-copper-plating

The results on the actual panels demonstrated:

1. Time savings: the plating time is reduced with more than 40% while maintaining the same plating spread.
2. More uniform deposits: the plating spread is reduced with 50%
3. Improved plating in holes: thickness on the middle of the walls and top/bottom are very similar



Conclusions

The industrial implementation and validation of the Elsyca IntelliTool approach clearly shows the benefits of using simulations to directly control the electroplating hardware.

Luc Smets, CEO Eurocircuits states "The test setup results are impressive: production capacity can be increased while maintaining the same quality, but it is also possible to reduce the copper thickness distribution. Another remarkable observation is that the copper follows the wall of holes even in the worst cases. It was decided to implement this technology in the production line in Hungary. "