Electroplating Thickness Variation – Fact and Fiction

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Electroplating thickness variations are a basic fact of "life in the plating room." Another fact is that there is usually a minimum specified plating thickness that must be deposited on any given cathode (the substrate or piece part).

A minimum plating thickness is chosen for a number of reasons, among them are function or decorative. For instance, function minimums are required for a specific reason, such as the need to carry power.

Dependant on cathode size and shape, plating thickness will vary. These variations can be minimal, say 1.0 mil in excess of thickness requirements, or they can be significant – five times or more in excess of the minimum specified thickness.

Take, for example, an automotive component that is complex in design and containing recessed plating areas. Flat surfaces are easy to plate, but recessed areas present a challenge. The flat surfaces, the sidewall and base of the recess create low *and* high current density zones, resulting in thicker or thinner plating on the same component. The component, an aluminum cast wheel for example, may require a plating thickness of 1.5 mils overall, but on high current density areas, the thickness of the plated metal can exceed 8.0 mils. Even if the excess thickness doesn't cause a problem, it nevertheless represents a waste of plating energy, time and raw material.

A flat cathode, like a printed circuit board (PCB), has fewer recesses and usually much less plating thickness variation (say 0.6 mils to 2.0+ mils), but its design and shape present other problems. Plating thickness on trace heights, isolated component pads and blind holes on different parts of the PCB can vary so significantly that it creates functional problems with current carrying capability, impedance matching, solder mask application and the assembly of components.

Solutions: some good, some not so good

Materials vendors offer chemical solutions, brighteners for example, that enhance throwing power on a micro scale. But any belief that a plating additive can successfully overcome high- or low-current density areas is fictional.

Plating engineers and plating equipment vendors are also attacking plating problems, but in different ways.

Manufacturers of power supplies are making significant strides in overcoming plating thickness variations. For instance, switch mode power supplies went a long way toward eliminating "ripple" as a factor in plating performance. Pulse and pulse reverse power supplies now make it possible to program the duty cycles of the power supply to more closely match the design of the platable area on the board.

A panel plated board without any blind holes could have a completely different plating cycle program than an HDI board containing numerous blind vias. The days of just hanging a cathode in the plating solution and letting it plate aren't nearly over yet but we're definitely making strides toward greater sophistication in the DC power supplied in electrodeposition.

Engineers are also finding that sophisticated, 3-dimensional plating simulation software can be used to analyze plating cell design and cathode geometry to accurately predict the plating thickness characteristics of any cathode, giving the engineer direction on how to set-up the plating cell.

Shields and/or plating thieves, for example, can be simulated before the part is plated and then rearranged to achieve optimal or, at least acceptable, plating thickness over the entire cathode substrate. The 3D software makes possible a "what if I" plating scenario in a matter of minutes.

A simple example is the analysis of the plating set-up for identical boards but which are plated in 2 different tank configurations at the same current density and for the same time, e.g., 15 asf (amps per square foot) for 90 minutes (**Figures 1&2)**.

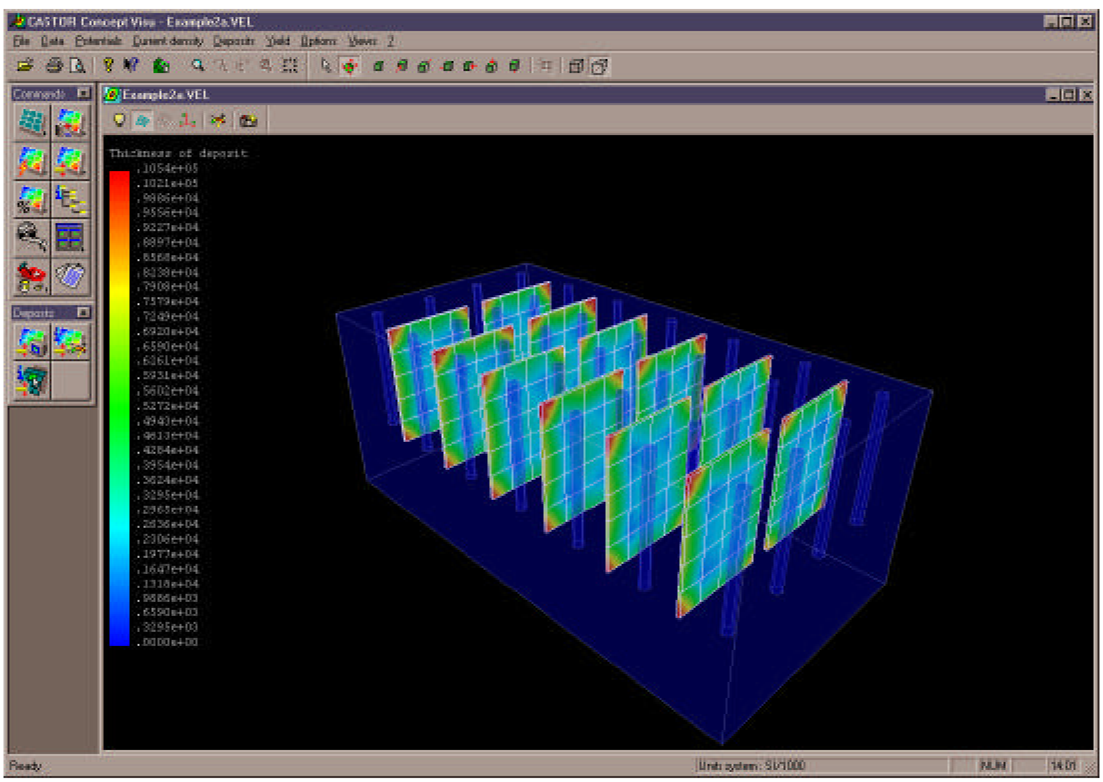

Figure 1

Take a close look at the plating characteristics of the respective tank set-ups. The simulated thickness of the deposit is displayed in colors and obviously varies considerably from one tank to the other.

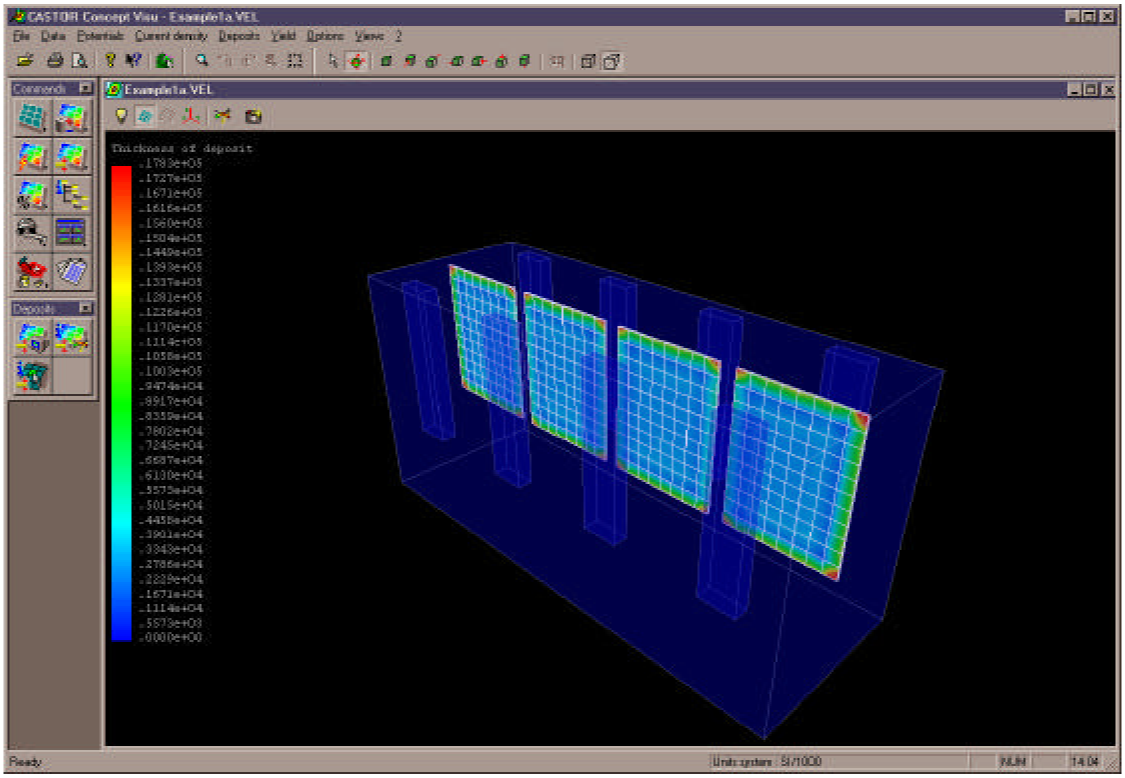

Figure 2

Another example of plating simulation is use of a simple shield **(Figure 3)** around the border of the cathode. Notice that the burning of the corners (rough plating indicated by red color at corners of graphic) is eliminated on this complex PCB, but the detail of the simulation reveals hot spots of plating thickness variation.

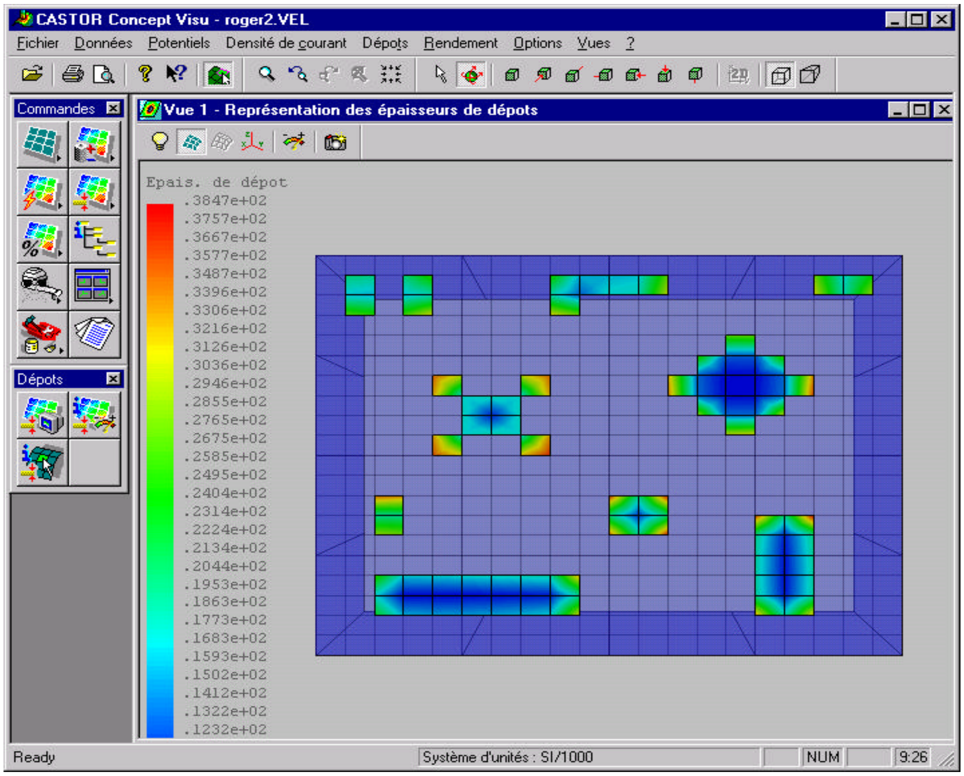

Figure 3

Conclusion

The future of plating bodes well for those that avail themselves of available technology and combine it with the engineering expertise made possible by 3D plating simulators that show the way to optimum plating cell/cathode configuration and improved plating thickness distribution.

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