Rectifying Electronics Finishing
What You Need to Know

by Pat F. Mentone

Computers are a billion dollar business, and there is no doubt that the industry will continue to grow as we advance through the 21st century. With this in mind, platers may be thinking of throwing their hat into the ring and beginning to perform electronics finishing. However, there are many areas that are different in electronics finishing that finishers should know about. One area that is important to look at is rectifiers.

A Little History

In industries such as printed circuit board and semiconductors, output from rectifiers must be precisely controlled. As electronic components have become smaller and smaller, the use of electroplating concepts to manufacture the components and interconnects between these devices has become significantly more important. Historically, the standard in the circuit board industry was to use one large rectifier for all of the plating tanks on an automated line. For example one 1,000 amp SCR rectifier could be used for three tanks with four panels being plated in each tank. The amount of copper (metal traditionally used in electronics finishing) plated on each panel would be the same as long as the resistance to each panel and to each anode was the same. Plating companies quickly found out that this never happened because of the difficulty in getting good electrical contact to each anode bar, anode basket, flight bar and to each panel on the flight bar. As the power requirements changed and the plating requirements continued to become more sophisticated, people started to specify outputs with the ripple less than 5 percent, so chokes and capacitors were used to smooth the output. The next evolutionary step was the use of one rectifier per tank. This idea helped, but there was still the problem of varying contact resistance to the baskets and panels.

The use of dual rectification was implemented to solve this problem. Dual rectification means using two rectifiers in each tank that are hooked up to the same cathodic panel. Each rectifier is also connected to the anodes on opposite sides of the panel. Using a separate rectifier for each side of the panel was the solution that helped solve the problem of varying contact.

A switch mode DC rectifier is the primary type used for this dual rectification. Dynatronix, a rectifier manufacturer based in Amery, WI, introduced switch mode plating power supplies in 1980. The advantage of using a switch mode supply is that the rectifier has a much smaller footprint than the equivalent "powerstat" or SCR style supply. It also provides little ripple and current regulation that is less than 1 percent of full scale. The switch mode supplies changes the frequency of the incoming power to approximately 40,000 hertz and then does the rectification. Using a higher frequency means that a much smaller transformer can be used, providing most of the space and weight savings.

The Next Step

In using the dual rectification process, the amount of copper on each side of the panel was easily controllable, but the problem of controlling the amount of copper inside the holes was still an issue. These holes become smaller as the number of metal layers through the hole increased. For example, to obtain 1 mil coating in the center of the hole, the typical amount of copper on the surface of the panel ended up being two to three times more than was needed. In addition, the plating times increased up to two to three hours.

Solving this problem was the next step that the industry had to overcome and was accomplished by installing pulse periodic reverse (PPR) rectifiers. By using PPR, which periodically reverses the rectifier output in one millisecond, and special chemistry, the proper amount of copper is plated in the hole rather than wasting excess copper on the surface of the board. In using PPR techniques, the results are increased throughput and decreased costs.

Rectifying Electronics Finishing
What You Need to Know

What's Next?

As the industry continues to expand and evolve, companies have worked to develop products to meet these changes, including Dynatronix. The company has developed a complete line of programmable rectifiers -- typically 10 to 20 volts rectifiers with currents ranging from a few milliamps up to and beyond 1,000 amps units - to be used in the semiconductor and printed circuit board industries. By incorporating a microprocessor into each rectifier, the output of the power supply can be DC, pulse or PPR. These rectifiers have three different control options. They can be controlled manually from the front touch-screen panel, from a PLC, or - by the preferred method of control - from a host computer either through a serial port connection or through and Ethernet connection.

The critical parameters to control are the type of regulation (constant current, constant voltage or crossover), pulse "on" time, "off" time, cathodic plating time, reverse time, and amplitudes of the forward and reverse currents. Typically, all of the timing settings are in milliseconds and the rise time of the pulse is between five and 50 microseconds depending on the amplitude. With the large array of parameters, there is almost an infinite variety of settings possible.

Using the onboard microprocessor along with the host computer will allow the user to write a rectifier program (commonly referred to as a recipe), and then download the recipe to the rectifier. The rectifier can then feed the operation data back to the PC for data logging and further process analysis. Within the recipe, the operator can set the mode of regulation, the output amplitude, the pulse timing, and the amount of time the rectifier is to run these conditions. The operator can then construct a second set of conditions and so on, only limited by the storage capacity of the PC. For every different part plated, the operator can scan in a part number, download a part specific recipe to the rectifier, and start the process to plate the part. During the plating cycle, the rectifier will store current and voltage readings and periodically send them back to the PC at whatever time interval the user selects. All of these technology advances are allowing users to plate printed circuit boards and semiconductors more efficiently and easily.

Summing it Up

The printed circuit board and semiconductor industries are ever-expanding and changing. With the advances made from dual rectification to PPR to computer-driven rectifiers, there is no telling what is on the horizon for the future of electronics finishing. Companies like Dynatronix, however, will always be striving to make this type of finishing a little easier.

About the Author

Pat F. Mentone PhD, CEF-SE has 30 years of experience in the plating and electroforming of electronic components. He has been a consultant for the last 15 years specializing in pulse plating and selective plating. He is the inventor or co-inventor of 5 patents. He holds a PhD in inorganic chemistry from the University of Minnesota. He can be contacted at pmentone@attbi.com.

This article was reprinted with permission from the January 2002 issue of Finisher's Management.