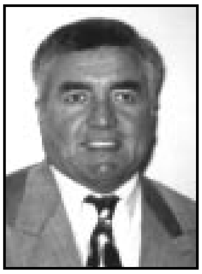

Design Engineering

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Advanced Electronics Finishing

Computer chips are getting smaller, as are circuit boards. Semiconductor vias are reducing dimensions, while increasing performance. Smaller and deeper through-hole plating allows more board levels and higher circuit density. This shrinking will only end when new technology cannot demonstrate the ability to revolutionize markets.

Printed circuit board (PCB) shops have typically been reluctant to invest in progress, perhaps for good reasons. But there is a lot of competition and many shops have fallen by the wayside. Profitability and survivability are the bases for adopting new technologies—here are some to consider.

Types of Electronics Finishing

Electroplated gold overlays do not need to be as thick if pulse-plated. Better overall coverage and uniformity (reduced edge and point buildup) occurs by producing smaller gold grains. The limit to thinness and coverage by application techniques and waveforms from rectifiers has yet to be realized.

Similarly, electroplated board surfaces and through-holes benefit from periodic pulsed reverse (PPR) plated copper. Some have even gone so far as to eliminate all additives by designing a copper bath with a PPR waveform. Copper electroplating requires an electrically conductive PCB surface.

The workhorse of PCB metallization has used tin-palladium catalyst clusters to grow electroless copper films. Human safety concerning formaldehyde drives electroless copper replacement. Alternatives are electroless nickel onto clustered palladium, direct copper plating over a conductive graphite film and, possible, direct copper plating over clustered palladium made electrically conductive by the presence of "bridging ligands."

A new process directly produces films on nonconductive substrates (including through-holes) for modern electrical circuitry. It uses ultraviolet light exposure through a patterned mask. UV initiates polymerization of pyrrole in the presence of silver (nitrate) and aniline. After removing unreacted solution, a 20-minute bake at 220 °F produces the electrically conductive circuit, ready to build with copper, etc.

Semiconductor manufacturing is replacing aluminum circuitry with copper. Typically, submicron circuit patterns etched into silicon gel plasma coated with two thin layers: A low-k barrier material, and copper. Copper electroplating then fills the rest of the trench or via, leaving the surface flat. Surface copper on the wafer is removed by chemical mechanical planarization (CMP) and annealed for the next layer. Improved CMP and plating were key to aluminum replacement.

Stringent requirements for cleanliness, planarity, conductivity, etc., were overcome in the semiconductor industry with reluctant acceptance of electroplating and wet chemical silica slurry pad processing (CMP). The copper electroplating step, derived from PCB advances from bumper plating, offers complete trench-filling capability. As in PCBs, PPR has advanced copper plating to fill the gaps without any bath additives, again with some room for improvement. It is anticipated that advances in PPR will soon eliminate CMP. **P&SF**