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UYEMURA INTERNATIONAL CORPORATION

UIC Chemistry Propels PCI to Apex of Rigid Flex Market

Printed Circuits Inc ("PCI") specializes in multilayer flex and rigid flex boards for DOE, DOD, aerospace, and other applications that prioritize ultra high reliability, and small package density.

"We've built rigid flex longer than anyone," says PCI Vice President Matt Tannehill, "and we were the first company certified for Mil Spec rigid flex. When we started in 1977, we built 'everything for everyone' – hard boards, metal cores. Then, in the early 90s, with the industry consolidation, we had the opportunity to move into rigid flex – arguably the most challenging arena.

"With one rigid flex board replacing 4 or more, boards go through manufacturing multiple times. Also, the materials have different coefficients of expansion, so drilling and registration are critical."

A privately held, third generation company headquartered in Minneapolis, PCI runs, in addition to the standard wet processes, an ENIG / ENEPIG line, electrolytic hard nickel gold, and EVF-R via fill – all Uyemura chemistries.

In July, 2017, it commissioned a 5th technology from Uyemura: an electrolytic platinum bath for an application in neurological diagnostics. It was installed as an extension to PCI's hard gold line, whose five prep stages it shares. PCI is the only printed circuit board shop in North America with electrolytic platinum as a final finish – a distinction that has created important new opportunities in the medical device market. *(Note: Uyemura supplies multiple electrolytic platinum lines for non-PCB applications.)*

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Thin, Void-free Electroless Copper

Enables Miniaturization, Reliability

Traditional electroless coppers have two shortcomings that produce challenges during manufacturing. Internal stress in the electroless copper deposit leads to blistered deposits, and poor adhesion of the deposit itself limits lines and spacing miniaturization.

Figure 1 shows a traditional electroless copper deposit with blisters and poor adhesion. Excessive internal stress causes the electroless copper deposit to blister off the substrate, and latent

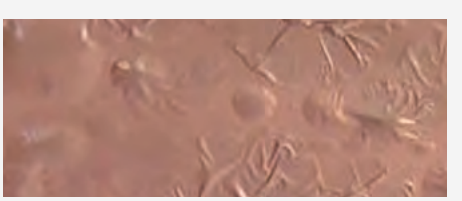

Figure 1. Traditional electroless copper deposit with blisters and adhesion issues.

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And now . . . On to what's ***Next!***

by: Don Walsh

After 38 years in the industry, the last 20 contributing to the amazing growth at UIC, it is time to retire. The first batch of grandkids, in Michigan, grew up mostly without me… I don't want that to happen to the younger group here in Connecticut.

This has been an amazing journey. I have witnessed the shrinkage of the connector industry in North America, then the sudden decrease in the costume jewelry industry in the late 90s---mostly in the Providence area, which lost 35,000 jobs in a four-year period. Then, PCB manufacturing went from over 300 American shops in the early 2000s to about 75 now.

Despite all that, UIC continued to grow here in North America, thanks to higher technology combined with more and better R&D, and the strongest commitment to customer service in the industry.

On a personal level, I was involved in the introduction of PALs tab platers to the US market; the sale of Robbins and Craig selective platers to the connector industry, and the first large-scale use of immersion gold on PCBs at Bally Manufacturing in Illinois in the 80s, all while at ACR.

UIC used our Japanese technology to take the commanding lead in the ENIG market and, through our own innovations, we became even stronger in the newer ENEPIG market.

Working with leading partner companies like Umicore GT (Germany), MEC (Japan and Belgium), KHW (Germany) and Europlasma (Belgium) has been exhilarating.

Our big excitement this year is the imminent installment of the first two MEC FlatBOND lines. We continue to bring the next levels of technology to our valued customers.

One of the true enjoyments in this career has been meeting so many people that have become true life friends. Seeing so many countries, and doing business in India and Israel, has been truly rewarding. My fondest memories will be my trips to Israel (thanks Avi and Sigal!), Germany, Japan, Taiwan and Sweden. Having visited Canada previously, I did not mention that country but would be remiss if I didn't rave about my business trips there and our wonderful relationship and mutual success with EMX.

Since 1980, I have done business with Precision Plating and Alchemitron / German Technology. I am proud of my long relationships with Becky and Chuck---thanks, friends! I feel the same bond with the good friends I have made with our industry associations (NASF and IPC) plus my media buddies Scott Walker (Products Finishing), Frances and Mike from PC Fab, and Angela from PCB 007.

Proof that "who you know" matters: I went to college with Mike Moffatt from PM Sales. In 1980, he recommended me to ACR to be Midwest Manager. That 15-year run was followed up a few years later with his referring me to UIC. That 20-year run brings us to the present---so how could I not thank him!! He is directly connected to the bulk of my career.

Obviously, I will miss many UIC customers that have become friends – and many UIC people that have become family.

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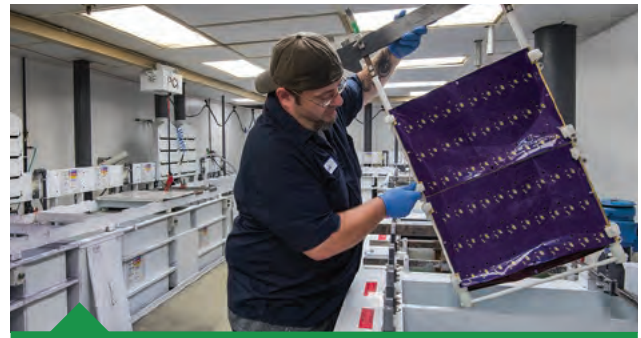
PCI processes 85% of its product through ENIG / ENEPIG. According to PCI Vice President Matt Tannehill, "we outsourced ENIG and ENEPIG, until a customer required in-house processing. We entertained multiple suppliers and chose Uyemura because of reports from other users and the strong advocacy of our quality manager." PCI has run ENIG / ENEPIG continuously since 2012.

Copper plating and wet process area at PCI.

"The key factor regarding ENEPIG – other than reliability – is the stability of the electroless palladium," says Tannehill. "In discussions with users of competitive products, we've learned that stability is a serious problem for them. The stability of the UIC chemistry, by contrast, is exceptional. Where a competitor's product's metal falls out, the Uyemura palladium stays in solution.

"This is critical: ENEPIG is still a 'new' final finish, not yet spec'd by a high number of OEMs and assembly people. We run a fair amount of it, but if it's not run for awhile, you can still just 'turn on the heat and go.' It does not crash-out like competitive products, so there's no need to replenish the metal component of the bath. This translates to a huge savings in time and cost.

Discrete point-to-point circuit tester measures the continuity of individual circuits just prior to final inspection.



Electrolytic nickel hard gold tank. On the left is the UIC ENIG/ ENEPIG line

"We have also experienced service that's the best we've had from any supplier," adds Tannehill. "(UIC Technical Specialist) Scott Butterfield is here often, and always when we need help. In the board building world, problems are never simple, and rarely black and white. Sometimes an anomaly on a board can easily be traced back to a process, but it helps to have suppliers who are knowledgeable, expert with various scenarios, and willing to share what they know in a timely manner.

"Today, the majority of chemistry and machine suppliers are sacrificing customer service for their own profitability," says Tannehill. "Or perhaps they just can't keep up. Either way, for a board shop, service is the most critical factor, next to quality chemistry, if you're going to run a high-reliability operation."

PCI Vice President Matt Tannehill with the company's V-scoring system

Tannehill believes that service is also what's powering the re-shoring that parts of the industry are experiencing. "For all but 'commodity' boards, responsiveness, language and expertise all work against low cost competitors from Asia. It's ironic that most US suppliers fail to exploit the powerful advantage that's right in front of them."

Developed and proved in Japan, Uyemura's ENEPIG palladium is today manufactured primarily at UIC's Connecticut Tech Center.

Thin, Void-free Electroless Copper

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internal stress reduces adhesion, prohibiting miniaturization of the circuits. To overcome these challenges, Uyemura developed the Thru-cup PEA electroless copper system.

Thru-cup PEA produces a low internal stress electroless copper deposit. The internal stress is both low and consistent, independent of thicknesses deposited; it persists throughout the bath life of the Thru-cup PEA process.

Figure 2 shows the low internal stress of the Thru-cup PEA electroless copper deposit, which is free of blisters and adhesion issues.

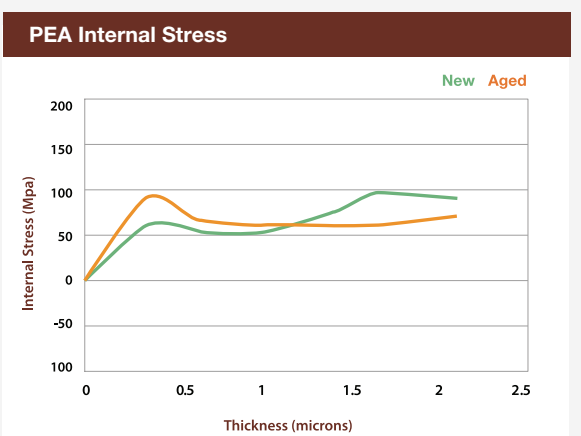

Figure 2. Internal stress of the PEA electroless copper deposit.

Adhesion is critical in semi-additive and fully additive processing. The miniaturization push continues to drive technology and reliability demands. Finer lines and spaces are required to meet these heightened demands for miniaturization.

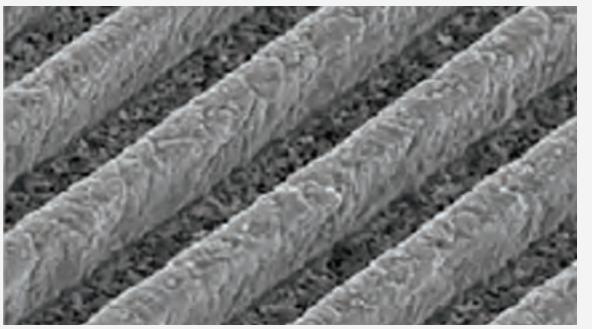

Figure 3. Two micron lines and spaces produced with PEA electroless copper.

As lines and spaces become finer, the need for thinner electroless copper deposits with enhanced adhesion becomes paramount to achieve miniaturization and reliability concurrently.

Thru-cup PEA electroless copper provides void-free coverage at thin deposit thicknesses and produces excellent adhesion, which enables miniaturization. Figure 3 shows two micron lines and spaces enabled by Thru-cup PEA electroless copper.

Adhesion is only valuable if the electroless copper system is stable and user friendly.

The Thru-cup PEA electroless copper bath is stable and has a long bath life. In addition, the bath is cyanide-free and easy to control using standard analytical procedures with an automatic controller for auto-dosing.

The properties and mode of deposition of Thru-cup PEA make is exceptionally well suited for semi-additive or fully additive PWBs, advanced packaging devices, and ceramics plating applications.