742F98024

NOTE

IPC-EPA DfE Direct Metalization Seminars Wrap Up in Phoenix

BY CHRISTOPHER RHODES

After seven cities and 350 participants, the IPC-EPA Design for the Environment (DfE) Making Holes Conductive (MHC) seminar roadshow is over. If you missed it, however, don't despair: If you couldn't make it to the roadshow, the roadshow will come to you.

This roadshow seminar presented the results of the Design for the Environment (DfE) Making Holes Conductive (MHC) Project to the PWB industry in a series of seven free seminars held around the country in 1997. The last one was held in conjunction with the Arizona Printed Circuits Association (APCA) meeting on 13 November in Phoenix, where approximately 60 PWB manufacturers learned about the effectiveness of seven MHC technologies (electroless copper, carbon, graphite, palladium, non-formaldehyde electroless copper, conductive polymer, and conductive ink).

The IPC-EPA DFE MHC project evaluated these seven MHC technologies in "real-world" settings. The results demonstrated that when implemented correctly, direct metalization technologies perform as well or better than standard electroless copper technology. Results also indicated that the alternative technologies may reduce costs and pose less risk to human health and the environment.

Detailed results of the DFE MHC Project will be published in a Cleaner Technologies Substitutes Assessment (CTSA) document in early 1998. The CTSA is a comprehensive analytical tool used to evaluate the health and environmental risks, performance and cost of alternative materials, processes and technologies. Prior to publication of the CTSA, however, these DFE seminars were used to present the bulk of the results to industry in a timely manner.

At the Phoenix seminar, MHC Project co-leader Kathy Hart, U.S. EPA, opened with an overview of the EPA DfE program in general and this MHC project in particular. Ted Smith of the Silicon Valley Toxics Coalition and Christopher Rhodes of IPC then provided community and industry perspectives on the advantages and objectives of the DfE approach.

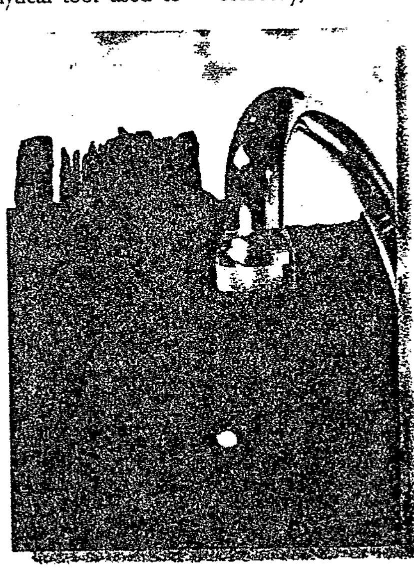
After that, Jack Geibig, Rupy Sawhney, and Lori Kincaid, all from the University of Tennessee, got into the meat of the seminar with presentations on methodology, modeling, data sources, risk characterization, cost analysis and resource consumption (water and energy).

Because there was too much data to cover in one day, Greg Pitts of MCC demonstrated how to find more DfE and related information on the Web. Bill Birch of PWB Interconnect Solutions then discussed the performance demonstration methodology and results.

The day wrapped up with discussions on MHC technology implementation from PWB manufacturers who have tried or investigated various MHC technologies. Gary Roper of HR Industries, Michael Kerr of Circuit Center and Rod Winn of Continental Circuits talked about their experiences with conductive polymers, carbon, graphite and palladium systems.

Summary of Project Results

The overall results indicate that MHC alternatives appear to pose less overall risk than non-conveyorized electroless copper. When implemented correctly, all of the MHC technologies achieve the same good performance results with high integrity plated through-holes. In most instances where the PTH was rejected, the problem was usually innerlayer-to-PTH barrel separation. Results also demonstrated an excellent correlation between electrical stress testing and mechanical microsection testing.



With respect to costs, data analysis show that all MHC alternatives should cut costs significantly over the non-conveyorized electroless process (25–80 percent cost reductions), in part due to large savings in water and energy consumption. Cost reductions, however, were only one reason companies gave for switching. Other reasons included the following:

- Improved worker safety
- Wider process window
- Ability to run various substrates
- Quicker throughput
- Improved hole wall integrity
- Compatible with small holes

Many companies also found that once the alternative technology was installed and debugged, other operational improvements resulted:

- Decreased maintenance
- Reduced waste management
- Reduced cycle times
- Reduced water and energy consumption
- Reduced labor and material costs
- Reduced handling

Lessons for Successful Implementation

Like many other things in life, if it's worth implementing an MHC alternative process, it's worth doing right. The question is, how do you do it right?

The answer, based on interviews and site visits with dozens of companies, is essentially this: don't skimp!

Don't skimp on equipment, training, support and commitment. Most companies emphasized the need to select high-quality equipment and maintain it carefully. If the equipment is poor, the process will fail.

Don't skimp on training. Switching to a new MHC technology involves far more than just hooking up some tanks and conveyors: it's affected by processes upstream and it affects the processes downstream. Thus, everyone involved from line operators to plant managers must take a "whole process" view of MHC technology installation and invest in the necessary training.

Don't skimp on support and commitment. Because the new MHC technology is so critical to process operations and product quality, company management and floor personnel alike must commit to understanding the process, working out the bugs, and ramping up to full production.

Following this approach, many companies have successfully implemented a new MHC technology and begun reaping the benefits. However, not all MHC technologies suit all types of PWBs. Therefore, it's crucial to do the homework, talk to other PWB manufacturers and proceed carefully when selecting a new MHC technology. The vast data gathered during the DfE MHC Project can help the selection process.

"Participating in the PWB Project provides many benefits to the PWB industry."

The following DfE PWB Project documents were provided to all seminar attendees and are available free to anyone who is interested:

1. *Implementing Cleaner Technologies in the Printed Wiring Board Industry: Making Holes Conductive*
2. *Printed Wiring Board Industry and Use Cluster Profile*
3. *Printed Wiring Board Pollution Prevention and Control: Analysis of Survey Results*
4. *Federal Environmental Regulations Affecting the Electronics Industry*
5. *Five Pollution Prevention Case Studies*

Now, if you missed the DfE seminars but are interested in the results, all of the documents are also available from the Pollution Prevention Information Clearinghouse at 202-260-1023. Most are also hot-linked to the Project Web page which is on IPC's Web site at http://www.ipc.org/html/ehstypes.htm#design.

Thanks to All

IPC and the U.S. EPA would like to thank John Lott of DuPont for his leadership on this project and all of the various regional circuit associations who helped sponsor seminars in their areas: California Circuits Association, Printed Circuit Alliance, Midwest Circuits Association, Chicagoland Circuitboard Association, NorthEast Circuits Association and the Arizona Circuits Association.

We would also like to thank the various companies who contributed to this project, including the following:

- ADI/Isola, who donated the materials
- H-R Industries, who built the boards
- Hadco, who electroplated the boards
- DEC Canada, who provided electrical stress testing
- Robisan Labs, who performed the microsectioning
- The 26 PWB facilities who ran the various MHC lines

Next DfE Project: Alternative Surface Finishes

The IPC Environmental, Health & Safety (EHS) Committee and the EPA are now planning and developing the next DfE Project on Alternative Surface Finishes (ASF). Gary Roper of H-R Industries is the IPC leader on this new DfE project.

This project will examine lead-free alternatives to the hot air solder leveling (HASL) process in order to identify those surface finish technology alternatives that perform competitively, are cost-effective and pose fewer potential environmental and health risks. The most commonly used PWB finishing technologies are HASL and electroplated tin-lead. These technologies may pose potential health and environmental risks due to the use of lead. The HASL process also generates significant quantities of excess solder that must be recycled.

"Don't skimp on support and commitment."

In addition to the HASL process, which will be tested as the baseline technology, the proposed alternatives for evaluation in this project include: both thick and thin organic solder protectorates, immersion tin, immersion silver, electroless palladium directly over copper and electroless nickel/immersion gold.

Limited data have been developed on the performance of these technologies by some earlier studies done by the Circuit Card Assembly and Materials Task Force (CCAMTF) and the National Center for Manufacturing Sciences (NCMS). No data have been generated on the health and environmental risks or costs of these technologies; however, the alternative technologies are expected to generate substantially less hazardous waste and may be more cost effective than the baseline technology. This project will supplement the work done by the CCAMTF. A study of these technologies will provide valuable information to both the PWB manufacturing and assembly industries. The project partners plan to complete the Surface Finishes CTSA in 1999.

Participating in the PWB Project provides many benefits to the PWB industry. For example, the information that results from the project helps individual companies proactively manage their environmental affairs, and it reduces the potential health and environmental impacts of their businesses, material and regulatory compliance costs and liabilities—all of which serve to increase competitiveness.

In particular, the industry benefits from the results of research on alternative technology risk, performance and cost conducted by neutral parties (EPA and the University of Tennessee). The PWB industry also benefits from EPA's risk assessment expertise and from access to the agency's unpublished data. In addition, EPA provides full-time project leadership, which facilitates the generation of critical data in a relatively short timeframe. The PWB industry's participation in the PWB Project ultimately benefits not only the industry, through risk reduction and cost savings, but also public health and the environment.

If you are interested in this new DfE ASF Project or would like more information about any of the DfE work being done, please contact Kathy Hart of the U.S. EPA by phone at 202-260-1707 or e-mail her at hart.kathy@epamail.epa.gov or hart.kathy@ epamail.epa.gov. You may also contact IPC Environmental & Safety Director Holly Evans in IPC's Washington office by phone at 202-638-6219 or via e-mail: hollyevans@ipc.org