EIPC NEWS

EIPC ANNOUNCE THEIR 4th TECHNICAL SNAPSHOT WEBINAR

We have been organising Technical snapshot webinars which will are of particular interest to those involved with automotive, telecom and high-speed technology. For the upcoming webinar, we will have three well-known PCB industry speakers, each of whom has their own view on the technology challenges facing this industry.

The upcoming webinar is scheduled on:

Wednesday January 20th.

The webinar will last for 45 minutes with each speaker taking 15 minutes for their presentations and then the webinar will be open for questions and comments from the participants.

Start webinar January 20th : 15.00 hrs

The webinar programme will be communicated asap.

Register online at www.eipc.org or send an email to kwestenberg@eipc.org

EIPC Technical Snapshot: PCB Surface Finishes

December 28, 2020 | Pete Starkey, I-Connect007

Reading time 6 min (1594 words)

For the third in a series of Technical Snapshot webinars, EIPC chose to focus on PCB surface finishes, comparing specific properties, examining corrosion behaviour and discussing selection criteria for low-loss, high frequency applications.

Dr. Laura Frisk

In a programme hosted and moderated by EIPC Technical Director Tarja Rapala-Virtanen, the opening presentation came from Dr. Laura Frisk, CEO of Trelic, a spin-off company from Tampere University of Technology in Finland that specialises in electronics materials and reliability testing. Referring to several studies of PCB finishes in which her team had participated, Frisk discussed the results of corrosion testing using different techniques.

Corrosion was an important consideration in choosing a suitable finish, especially as electronic devices were expected to work in increasingly demanding environments—one typical example is the mining industry. As features sizes continued to diminish and density increased, corrosion became a key reliability risk, with early failure a probable consequence. Different metallic layers increased the susceptibility to galvanic corrosion and, especially in instances of crevice corrosion, failure could happen very quickly. It was critical to understand corrosion behaviour, how to test it, and how to mitigate it.

High humidity was required to support the majority of corrosion mechanisms. Contaminants contributing to corrosion could originate from many sources, and several different test methods could be employed, using relevant corrosive chemicals such as chlorine, as chlorine gas or sodium chloride, sulphur, as sulphur dioxide or hydrogen sulphide, and nitrogen dioxide.

Frisk described the principles of salt-spray testing, flowers-of-sulphur testing for creep corrosion on PCBs, and mixed-flowing-gas testing of electronic components and assemblies, as well as humidity testing for studying the effect of residual impurities on products.

Her examples of PCB surface finish options were hot air solder levelled (HASL), electroless nickel immersion gold (ENIG), immersion tin, immersion silver, and organic solderability preservative (OSP). She demonstrated how different finishes were vulnerable to different corrosive elements, remarking that the quality of surface finish was critical, and that certain finishes were consumed during the soldering operation.

Summarising test results, she explained how a 1,500-hour salt-spray test revealed significant corrosion on ENIG and OSP, and some corrosion—but no failures on immersion silver. A six-week mixed-flowing-gas test gave significant creep corrosion on ENIG and OSP, and lots of corrosion products on HASL. Immersion silver and immersion tin showed clear evidence of corrosion but the corrosion products spread less than with HASL and ENIG. Flowers-of-sulphur testing for five days at different levels of humidity showed significant corrosion of immersion silver, some corrosion of immersion tin and very little corrosion of ENIG. The effect of humidity was not linear. All of the test results were clearly illustrated with photographs and microsections. She commented that conformal coating could be used to protect surfaces from corrosion, but this was a subject for a separate discussion.

Dr. Britta Schafsteller

Even if judged purely on considerations of corrosion, Frisk's results had plainly indicated that no single finish covered all expectations. An in-depth comparison of the key properties, benefits and limitations of different surface finishes came from the second speaker, Dr. Britta Schafsteller, global product manager-selective finishing with Atotech in Berlin.

Summarising the task of a surface finish, it was required to protect the copper surface from tarnishing and oxidation, and to maintain an active surface for various interconnect techniques. Schafsteller's slide illustrating "various interconnect techniques" gave an indication of the breadth of choice of finish, ranging from organic solderability preservatives (OSP) and hot air solder levelled (HASL), through immersion tin, immersion silver, electroless nickel immersion gold (ENIG), electroless nickel electroless palladium immersion gold (ENEPIG), and electroless palladium autocatalytic gold (EPAG), to electroplated nickel electroplated gold (E-Ni/E-Au). And with a range of functional requirements including single soldering, multiple soldering, copper-wire bonding, aluminium-wire bonding, gold-wire bonding, touch-contacts, press-fit and adhesive bonding, together with many permutations and combinations, the selection was extraordinarily complex.

Describing individual finishes, she began with OSPs, a series of chemistries that had evolved through several generations from simple benzotriazole to various substituted benzimidazoles. OSPs were used mainly on consumer products and, to a limited extent, in automotive applications. The application process was simple and the finish was displaced in the soldering operation, enabling a copper-tin intermetallic joint. A nitrogen atmosphere was required for soldering and the finish had a relatively short storage life,

Immersion tin was widely used in automotive applications. Deposition of the finish involved a chemical displacement reaction whereby copper was replaced by tin. Relatively low-cost, it had reasonably good shelf life and corrosion resistance. Soldering produced a copper-tin intermetallic joint, and the finish could also be used in press-fit applications. It was suitable for use in high frequency electronics. Precautions were required to control whisker growth. Because the deposition chemistry was acidic it could attack solder mask, and good rinsing was essential to avoid ionic contamination.

ENIG had a long shelf life and was suitable for multiple lead-free soldering cycles. The gold was dissolved by the solder and a tin-nickel intermetallic joint was formed, with nickel acting as a diffusion barrier between solder and copper. The finish was suitable for aluminium wire-bonding and touch-contact applications. The precious metal cost made it an expensive finish, and, because of the presence of the nickel

layer, solder joints tended to be brittle and it were not suitable for high frequency applications.

Compared with ENIG, ENEPIG was suitable for both aluminium and gold wire-bonding and gave a higher level of solder joint reliability, because the palladium layer acted as a barrier against hyper-corrosion during gold deposition and also reduced the formation of brittle tin-nickel intermetallic. But the overall process was relatively complex and required tight control.

EPAG (electroless palladium autocatalytic gold) eliminated the nickel layer and enabled reliable solder joints to be formed through a ductile tin-copper intermetallic. It was suitable for multiple soldering with both tin-lead and lead-free alloys, as well as wire-bonding with pure-copper, copper-palladium and gold wire. And it was appropriate for high frequency applications. However, it was a relatively new finish with higher process costs because of the precious metal content.

The metallurgy of solder-joint intermetallic compounds had been extensively studied across the whole range of finishes, before and after aging, and Schafsteller showed the results of high-speed shear-tests that had been used to compare joint strengths and fracture energies.

She commented that specific applications required specific finishes, and that the choice of finish should represent a balance between cost and application needs. The target of her team's new developments was to address multiple applications at reduced process cost with competitive performance.

She ended her presentation with a glimpse of a new palladium electrolyte for pure deposits, a new mixed-reaction gold designed to avoid corrosive attack in ENIG and ENEPIG applications, and a fully autocatalytic tin process with no limitation in plating thickness.

Dr. Kunai Shah

It had already been mentioned that PCB finishes could significantly affect the integrity of high-frequency, high-speed electronic signals, and particularly that finishes based on electroless nickel were not ideal candidates for such applications because of insertion-loss effects. Dr. Kunal Shah, president and chief scientist at LiloTree, illustrated this with a graph of loss versus frequency comparing an uncoated copper conductor with one finished in ENIG, showing that at 50GHz the loss for the ENIG example was more than 50% greater than that of bare copper as a consequence of nickel's inferior conductivity and ferromagnetic properties.

It was clear that a less “lossy” finish was required for 5G applications, and that the elimination of electroless nickel would also overcome possible hyper-corrosion and brittle-solder-joint effects. Shah commented that currently available nickel-free finishes—such as electroless palladium immersion gold (EPIG), electroless palladium autocatalytic gold (EPAG) and direct immersion gold (DIG)—did not meet all of the criteria for high frequency applications, with concerns of higher insertion loss and brittle solder joints as consequences of resorting to greater thicknesses of precious metals which were neither cost-effective nor eco-friendly.

He described an innovative nickel-less approach by depositing a proprietary nano-engineered barrier on copper features as a foundation for 50 nanometre layer of cyanide-free gold. The gold thickness was significantly less than that of DIG or EPIG or EPAG, with corresponding savings in precious metal cost and less risk of solder joint embrittlement. The finish was applied in a simple 8-tank process line of four active stages and four rinses.

Results were impressive. The graph of loss versus frequency showed the insertion loss of the new finish to be almost identical to that of bare Cu over the 0-100GHz frequency range.

The effectiveness of the barrier layer in preventing diffusion of copper into the gold was demonstrated by the absence of any corrosion products on the gold surface after six reflow cycles.

Solderability testing to MIL-STD-883 Method 2003 after eight hours of steam conditioning followed by dry baking at 100°C for one hour in nitrogen showed no evidence of failure, and the characteristics of the copper-tin intermetallic layers were considered superior to those formed with EPIG or EPAG. Neither were any brittle intermetallic solder joint failures observed in pull and shear tests. These results indicated that, in addition to its superior high-frequency performance, the new finish offered better solder-joint reliability as well as significant savings in gold usage compared with ENIG and ENEPIG.

After moderating the question-and-answer session, Tarja Rapala-Virtanen thanked the presenters and attendees, as well as her EIPC colleagues for organising another successful technical snapshot event. Wishing a happy Christmas to all, she announced that the next webinar was scheduled for January 20, although she hoped that 2021 would bring opportunities for returning to EIPC's renowned live conferences.

EIPC SPEeDNEWS

The Weekly On-Line Newsletter from the European Institute of Printed Circuits.
Issue 1 – January 2021

NEWS FROM THE NETHERLANDS

CCI Eurolam Group Signs Agreement to Acquire Adeon Technologies BV

CCI Eurolam Group, a leading distributor and industrial service provider to the EMEA electronics manufacturing industry, announced the signature of an agreement to acquire Adeon Technologies BV, a major full service provider of equipment for the European PCB Industry.

Alain Kahn, President of the CCI Eurolam group: “We are thrilled to welcome Adeon into the CCI Eurolam family. The current context shows a strong dynamics regarding manufacturing and we are excited to participate and support the favorable industrial investment trend in the EMEA region.”

Samuel Bismuth, Business Development Manager at CCI Eurolam Group commented: “There is a strong strategic fit between our companies and with the support of the CCI Eurolam Group; Adeon will keep strengthening its capabilities to expand and accelerate its growth. We believe that in the next decade, Equipments will be more than ever a strategic driver for technology in the electronics manufacturing industry and that Adeon is the right partner for the future.”

Andre Bodegom, Managing Director and owner of Adeon said, “At Adeon, we have been able to develop over the last 10 years a strong expertise in selling and servicing equipment over the EMEA region partnering with leading equipment manufacturers. As we started discussion with CCI Eurolam, it immediately became apparent that both healthy companies have a lot to offer to each other. The European PCB market is developing rapidly into various highly specialised companies, for which the combined expertise of CCI and Adeon will create a lot of Added Value. Becoming part of the strong and renowned CCI Group of companies will allow us to materialise our growth plans for the future in an even faster pace. Adeon will continue to operate from its base in Breda, The Netherlands in a *business as usual* manner."

The European Institute for the PCB Community

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ELECTRONIC INDUSTRY NEWS

Is This The End Of Made In China?

Enrique Dans

In early July, an important announcement by Apple went relatively unnoticed: it was shifting assembly of its iPhone 11, then the most advanced model in its product line, from China to Chennai in India.

A couple of weeks later, Samsung, along with several other Apple suppliers (Foxconn, Pegatron and Wistron), Indian manufacturers Micromax and Lava, and up to 18 other companies applied for an Indian government incentive program for the large-scale manufacture of electronic products, that would see a significant part of these companies' manufacturing transferred to the subcontinent.

On the one hand this will allow them to avoid the 20% levy that India, one of the world's most important markets in quantitative terms, imposes on imported electronics, within its increasingly protective trade policy. Perhaps more importantly, it reflects deeper macroeconomic issues to do with China's higher costs, as well as the mechanization of production, which means less dependence on labour.

At the same time, the Biden administration is expected to keep up pressure on China, and will exhort its allies to do the same, in a bid to force Beijing to open up the country to competition and hopefully to respect its citizens' human rights.
Likewise, the transfer of some of Apple's assembly to Vietnam has helped the local economy of China's neighbour.

Are we witnessing a change in the economic cycle? In the latter half of the last century, China set out to create a scenario in which Made in China would be replaced by Engineered in China: the country would no longer be the world's factory, a cheap place for the world to outsource manufacturing, and instead an advanced source of technology. At the same time, Chinese companies have increased automation, causing some of them to send up to 80% of their workers home and switch to using robots instead. The higher level of specialization of the production line workers — typically experts in machine maintenance, machine learning — generates higher wages, while mechanized factories with higher output fewer errors and accidents also means that wage costs are no longer such an important .

In the consumer electronics industry, staying on Chinese soil still has its advantages, mainly in terms of maintaining proximity to suppliers. But increasingly, these companies are becoming global and can consider offering services and solving problems almost anywhere in the world, which could lead to pressure to progressively relocate production.

With labour costs no longer an issue, more mechanization and a tendency to relocate production, could the future see Western companies putting more pressure on China to avoid possible sanctions and blockades at home and to try to bring value closer to the countries that design or consume their goods?

And if so, within what timeframe?

Enrique Dans
Teaching Innovation at IE Business School since 1990, and now, hacking education as Senior Advisor for Digital Transformation at IE University. BSc (Universidade de

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NEWS FROM THE UK

Reminder - Free Online "Research Showcase"

"Recent Advances on Reliability and Gate Driving of WBG Power Electronics"

Monday 11 and Tuesday 12 January 2021: 10:00 - 12:30
Hear about the Latest Research on Power Electronics from
Warwick, Nottingham Bristol, Newcastle, Edinburgh and Aalborg Universities

This **Research Showcase** addresses several of the key issues critical to the increased adoption of **Wide Bandgap (WBG) Semiconductors** within the growing power electronics industry, including:

- Gate Interface Reliability in SiC/GaN power devices
- Latest Advances in Packaging/Interconnects
- High Speed Sensing and Monitoring around GaN devices
- Optimisation of switching transients for SIC MOSFETs
- High Current SiC Applications
- Testing of SiC MOSFETs under normal and abnormal operations

*Registration is **free** for this event.*

Register Here

Forthcoming IMAPS-UK Online Events
Please Click on the Links below for More Information
Semiconductor Packaging Workshop Online
Thursday 11 February 2021
MicroTech 2021 Online Conference - Heterogeneous Integration - Packaging Future Microsystems
Thursday 25 March 2021

News from WECC members

WECC World Electronic Circuits Council

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NEWS FROM THE IPC

IPC Promotes Sanjay Huprikar to President of Europe and South Asia Operations

BANNOCKBURN, Ill., USA, January 5, 2021 – Effective January 1, 2021, IPC has promoted Sanjay Huprikar to president of Europe and South Asia Operations.

In his new role, Huprikar will lead IPC's globalization initiative to expand the association's standards, education and advocacy support to Europe, the United Kingdom, India, and several countries in Southeast Asia including Malaysia, Singapore, Indonesia, and the Philippines.

Huprikar has served as vice president of Solutions since 2017 directing global teams to develop new products and services for the electronics manufacturing industry. Prior to leading the Solutions team, Huprikar served as vice president of the member success team, overseeing IPC membership, events, industry programs and market research functions and has been with IPC since 2012.

A highly experienced business and engineering professional, Huprikar has served numerous multi-national companies in the technology space since 1989. He has strong cross-cultural leadership skills and vast knowledge of both the key influencers in the global community and the important challenges facing the industry.

"Sanjay has great skill in engaging the electronics community – keeping his ears to the ground and identifying new opportunities that add value to our industry. Examples include his leadership in automotive electronics, Europe expansion, e-textiles, factory of the future initiative and IPC's video library subscription offerings," said John Mitchell, IPC president and CEO. "We're looking forward to Sanjay applying his talents to furthering IPC's mission in Europe and South Asia."

Huprikar has a master's degree in Business Administration from the Stuart School of Business - Illinois Institute of Technology and a Bachelor of Science degree in Electrical

Engineering from the University of Illinois at Urbana-Champaign. He can be reached at SanjayHuprikar@ipc.org or +1 847-597-2837.

North American PCB Industry Sales up 1 Percent in November

IPC Releases PCB Industry Results for November 2020

IPC have announced the November 2020 findings from its North American Printed Circuit Board (PCB) Statistical Program. The book-to-bill ratio stands at 1.05.

Total North American PCB shipments in November 2020 were up 1.0 percent compared to the same month last year. Compared to the preceding month, November shipments fell 2.5 percent.

PCB bookings in November rose 17.1 percent year-over-year and increased 13.6 percent from the previous month.

"PCB shipments and orders continue to be somewhat volatile but remain in line with recent trends," said Shawn DuBravac, IPC's chief economist. "While shipments slipped slightly below the recent average, orders rose above their respective average and are 17 percent higher than a year-ago."

Detailed Data Available

Companies that participate in IPC's North American PCB Statistical Program have access to detailed findings on rigid PCB and flexible circuit sales and orders, including separate rigid and flex book-to-bill ratios, growth trends by product types and company size tiers, demand for prototypes, sales growth to military and medical markets, and other timely data.

Interpreting the Data

The book-to-bill ratios are calculated by dividing the value of orders booked over the past three months by the value of sales billed during the same period from companies in IPC's survey sample. A ratio of more than 1.00 suggests that current demand is ahead of supply, which is a positive indicator for sales growth over the next three to twelve months. A ratio of less than 1.00 indicates the reverse.

Year-on-year and year-to-date growth rates provide the most meaningful view of industry growth. Month-to-month comparisons should be made with caution as they reflect seasonal effects and short-term volatility. Because bookings tend to be more volatile than shipments, changes in the book-to-bill ratios from month to month might not be significant unless a trend of more than three consecutive months is apparent. It is also important to consider changes in both bookings and shipments to understand what is driving changes in the book-to-bill ratio.

IPC's monthly PCB industry statistics are based on data provided by a representative sample of both rigid PCB and flexible circuit manufacturers selling in the USA and Canada. IPC publishes the PCB book-to-bill ratio by the end of each month.

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International Diary

2021

EIPC Technical Snapshot Webinar
Registrations via www.eipc.org
January 20

IPC APEX EXPO
March
San Diego, USA

EIPC @ SMTconnect
May 4-6
Nuremberg, Germany