

Review
EIPC SUMMER CONFERENCE 2010
June 7th & 8th 2010
CCN Congress Centre Nürnberg Germany.



Giacomo Angeloni, Vice-Chairman of EIPC, welcomed the delegates to the first EIPC Conference held in Nürnberg. His light-hearted approach to the situation was a very agreeable way in which to begin, with a look at European legislation and how Europe is run (or purports to be run) and how the economic situation will fan out in the months to come. He encourages building the strengths of associations as groups where synergies are words, whereby we can look after ourselves, and through which we may influence others to mutual benefit.

No EIPC conference could, in all decency, contemplate beginning without the benign face of **Walt Custer of Custer Consulting Corporation** appearing to address the faithful. He thinks that the outlook is a little better since the last time he spoke to us five months ago. Asia is leading the recovery, semiconductors are back to pre-crash levels, and we are going to see huge growth rates. World industrial production is in growth mode, electronic equipment manufacturing is up 18%, and whilst inventory levels are low they will not hold



back the manufacturing needed to meet demand, now approaching \$150 billion per month globally. Many of the charts we saw five months ago had a lot of red on them; now most charts show green, representing growth rates, which is excellent, but not surprisingly Europe is lagging the Far East, about three months behind. Nuggets of news included the fact that Nokia have 35% share of the mobile 'phone market, but they are under pressure. Demand for PC's will see 377 million units sold this year alone. Apple is up 65% up in the Q1 this year. Semiconductor shipments see 50% growth, and SE Asia dominates, with 56% of the world market share. The PCB world market was worth \$59 billion in 2008. The Austrian company AT&S are the 15th biggest worldwide. Germany had the biggest market share in 2009, at 38%. Austria is No. 2, all reflecting the feeling being felt on the shop floors of factories around the world. For the future, growth rates are peaking now, with PCBs up 10% from an extremely low base.

Francesca Stern from BPA followed with a look at opportunities in the supply chain for large area printed electronics, following a 5 year study by her company. Existing applications include E-readers, RFID tags and PV solar cells, and nascent application include wearable computers and smart clothing; smart RFID labels and smart active labels; lighting, and gaming cards. In the lighting field it is all about OLEDs, which have lower energy costs, lower fabrication costs and lower whole life costs, and lend themselves well to contemporary design. Drivers for RFID tags were lower material and lower manufacturing costs, in fact lower costs was a driver in all fields of notable printed electronic applications. Francesca looked at the various printing processes involved, including flexography, soft lithography, gravure and screen print, inkjet and thermal ablation, depending upon the layer count going down on to the substrate. Substrates fall into various categories - barrier; conducting; semi-conducting; non-conducting, light emissive and E-paper. Looking at these possible applications, and opportunities based on market potentials, OLEDs offered the biggest potential, E-Readers came second, then small OLEDs for mobile 'phones etc. Based on BPA's Printed Electronics Market

Opportunity Analysis, total world value of printed electronics was estimated to be about \$4.5 billion for 2010 and forecast to grow to \$13.2 billion by 2015.

In the session entitled Lean PCB Production, Advanced Technology and How to Gain Efficiency, the first speaker was [Arieh Reichart](#), CEO of Eltek in Israel, whose subject was Waste on the Shop-Floor, Hidden Potential for Cost Saving. In a fiercely competitively manufacturing environment where mass production had gone forever and there were no more rabbits to pull out of the hat, it was necessary to look inwards at the manufacturing facility for potential cost savings. Survival in challenging times was critically dependent on the cost structure of the operation, and a significant potential for improving cost structure lay in the elimination of waste - any activity that added cost or time but did not add value to the customer. The principle of lean manufacturing was to make exactly what was needed, when it was needed and in the amount in which it was needed, and the heart of lean manufacturing was the willingness to look deeply into the root-cause of any factory problem and solve it by eliminating the causes. He demonstrated how a paradigm could be created, using the analogy of monkeys, step-ladders, bananas and cold showers, where no-one could remember what was the historical origin of a "we've always done it this way" scenario. Quoting Einstein, he remarked that only two things were infinite: the universe and human stupidity, and he was not sure about the former!



Do something and be brave! Motivated by a desire to see PCB manufacturers recognised and respected for employing talented people and constantly responding to the needs of a fast-changing world, [Steve Driver of Spirit Circuits](#) in the UK gave a positive and refreshingly candid presentation entitled The Future of PCBs in Europe - How Can the Industry Survive? Well-experienced in the ups and downs of the industry, and frustrated to hear buyers talking only about price, without giving consideration to the service or the value of the supply chain the PCB industry had built up to support their needs, he set out to challenge the mind-set of both the PCB manufacturer and the PCB purchaser. The traditional PCB had no place in Europe - the future lay in high-mix, quick-turn, complex, small batch work, with a high level of service. He gave an enormous amount of intelligent advice and guidance, taking his own company as the model, on marketing your business, finding the customer you probably already knew, eliminating their perception of your indifference, developing a market-leader strategy and a positive energy towards change. He listed many reasons why buyers should choose European manufacturers, and shared some novel selling techniques that Spirit had instigated. This was a motivational tutorial for anyone involved in the PCB business, whether buying or selling, and Steve Driver is to be congratulated for his initiative.

[Pierre-Emmanuel Goutorbe](#), Technical Manager with [CIRE Group](#) in France, gave an overview of printed circuit board technologies for thermal management. Several options were available: single-sided or double-sided boards with heat sinks, multilayer board with thick copper, rigid or flexible insulated metal substrates and sequential build-up, and these technologies included a variety of base materials, bonding methods, surface treatments and build-up for both high-reliability and consumer products. He detailed the main characteristics of a series of insulated metal substrate constructions and explored various alternatives such as button plating, bonded heat sinks and carbon-core multilayers. Higher-level integration in electronics made thermal management an increasingly important consideration, which required the PCB manufacturer to have good knowledge of technical solutions, materials and bonding methods and to make appropriate choices according to thermal performance and cost, and whether low available space and weight were key factors. The technology trend was towards base materials with high thermal conductivity and CTE matching with the substrate.



Dr Gregor Langer of AT&S continued on the theme of thermal management, this time with substrates for LED applications as the topic. Analysing causes of deficiency in electrical systems, he demonstrated that the principal cause of failure was temperature. Vibration, dust and humidity were minor factors by comparison. Observing the rapid trend to the replacement of incandescent lighting by LED, he emphasised the importance of thermal management in realising the advantages of LED, and reviewed the evolution of package enhancements to improve their thermal efficiency, Co-operation between AT&S and Hausermann had resulted in the development of processes for the incorporation of copper wires and copper profiles into standard FR4 substrates, which enabled the use of high currents in extremely small spaces without overheating. Various other thermal substrate options, with W/mK values between 0.5 and 8.0 were currently being evaluated in a co-operative programme with OSRAM and the Institute of Sensor and Actuator Systems, using steady-state thermocouple measurements to measure thermal resistance. Of particular interest was the transient effects which happen in the initial stages of switching-on a device. The results were due to be made public at ESTC 2010 in Berlin next September.

Frank Dietrich of Würth Elektronik described a smart polymer thick film technology which would allow the industry to take a big step forward in space reduction, reliability improvement and sensor integration whilst using existing PCB processing infrastructure. He showed applications employing modified conductive polymers on specially structured PCBs enabling the production of sensors similar to MEMS, abrasion-free potentiometers and switches, and extremely sensitive strain gauges, as well as push-button switches with no moving parts. The smart implementation of conductive-polymer passives had opened a wide range of cost-effective and environmentally friendly applications with no compromise in quality.

Eugene Raemaekers from Q.P.I. Circuits in the Netherlands reported progress in the European-funded STELLA project, in the process development of three-dimensionally stretchable printed circuits for medical applications, as well as interconnections between moving actuators and equipment. Of the substrate concepts which had been evaluated, the most practicable was a laminated copper-polyurethane film material, which could be



processed by existing PCB technology. Stretchability of conductors was achieved using a meander-pattern design rule. He described a trampoline-style test which had demonstrated the remarkable durability of circuits under bending and stretching conditions, and showed examples of real applications in medical electronics, including pressure-point monitors for shoes and wound-healing monitors. Active components could be assembled onto “stretch-rigid” substrates using low-melting-point solders or conductive adhesives. Fascinating look at some clever circuitry.

The Future of TBBPA in PCBs was the title of the paper from **Guillaume Artois of Albermarle**. He listed the EU Risk Assessment, the US EPA DIE Programme TBBPA & REACH; EU RoHS Directive; PCBs end of life and TBBPA as the main topics of his talk. TBBPA has been the flame retardant of choice for PCBs for more than 30 years, is present in PCB laminates, which are required to meet high flammability standards. The controversial EU Risk Assessment started in 2002, ended in 2008, and finally concluded that with TBBPA in PCB applications there were no risk for the environment nor for health, and no risk reduction measures. It is not a CMR, nor a PBT, nor a vPvB; it is fully compatible with REACH. TBBPA is allowed for use anywhere in the world. and is the most documented flame retardants in the world.

The US Design for the Environment programme focuses on environmental safety and health aspects of FRs in PCBs. See proceedings here as it is good.

Raymond Gales of Circuit Foils, Luxembourg spoke on the latest developments in ED-copper foils for high-speed circuitry. His company produces 11,000 tonnes copper foil per annum, of which 50% now is thinner than 20 microns, and two-thirds of production is exported to Asia. Last year turnover was \$65 billion. The high end of the market will expand to 6 million sq. metres next year, and the strongest increase will be in the high speed digital market in the 5 Gbps range. So a new foil type is required, of low profile, so the need is to reduce skin effect, and they have a new treatment giving an ultra flat surface, which will not however work with all resin systems. BF film has a very low profile, and here was an interesting description of work done to reduce profiles. Also, they have a primer coated range which ensures a secure bond for high reliability despite lower roughness profiles. Flash etching is very fast, the new foil types are much more even, and the profile is less rough, which can be etched much faster. Using an Atotech primer @ 3µm DFT they have improved the peel strength on halogen-free laminates by over 30%.

Carsten Ihmels of Nabaltec AG, Germany had a succinct title - Thermally stable Boehmites as Halogen Free Goldman Retardant Filters allow the manufacture of Green E&E Products with highest quality and reliability. Dr. Carsten believes that Boehmites can help in the field of thermal stability and service life, and set out to make the case. Boehmite is an aluminium oxide hydroxide., is halogen free, has high heat resistance, and very low viscosity. It has a synergistic effect on flame retardants when used in combination with ATH, and when used with ATH in PCB laminates it works rather well. ATH alone does not have such high heat tolerance, which always occurs in lead-free soldering but if ATH is combined with Boehmite then there is a 50% cost improvement. better thermal resistance, good compatibility to polymers and good processability. So there is a big new market. which is already being exploited. Boehmite has been used in IC substrates for packing since 2008, and 2010 is starting to be used in halogen-free FR4 prepregs and laminates, and is under assessment for use in epoxy moulding compounds.

Alun Morgan of Isola AG launched with gusto into his roadmap for advanced laminates development to meet the demands of lead-free and high temperature LED application and multiple soldering processes. Alun makes a complicated subject sound quite straightforward, which it obviously isn't. Lead-free soldering brought about differences in peak assembly temperatures, plus different assembly cycles, and Isola met these by using phenolic curing chemistry instead of a dicy curing system. In the future they will use a non-dicy and non-phenolic curing chemistry, which will give much better performance. In the thermal cycling arena, there is a need to be below 3.5 unfilled, or 2.8 filled, and Alun explained how easy it was to do this for low z-axis expansion materials. Apparently they are approaching 8 ppm per degree C in filler terms, which is obviously good. LEDs excite Alun, and to his delight they are being used everywhere. They have many advantages, and in the automotive field they are universally employed in many applications. As a laminate man to the core, he described how temperature related to luminosity and colour and all very interesting it was, too.

Paul Reid of PWB Interconnect Solutions is keen on reliability and he ran an excellent workshop on Tuesday afternoon which was very well attended. The effects of lead-free were highlighted, and he explained how the circuit board had become the component of failure. The higher HDI application creates demand of aspect ratios of 40:1 for drilling, and high temperatures have created a high vulnerability to failure. Lead-free impact on reliability was manifested in significant pad rotation, barrel cracks to corner cracks, delamination, pad lift, dough nut delamination, and cratering. Paul is an animator, and as a result we had some animated pictures which showed, somewhat alarmingly, what happened to a circuit board during its thermal excursion. The old synergy between tin/lead and copper has been destroyed and the stresses and strains caused by the move to lead-free were superbly illustrated. This was a fascinating presentation given by a consummate professional and he held the attention of all present.

Day 2 - June 8th

The day began with **Nils Arendt of Enthone GmbH** talking about corrosion protection for immersion silver coated PCBs. Metallic corrosion is prevalent with immersion silver and ENIG. It comes in two forms, creep corrosion and flaking corrosion. Where electrochemical migration is seen, this is formed by the electrical gradient. He described various test methods to simulate the harsh conditions which circuit boards can find themselves in, being exposed to such elements as sulphur, or where copper is exposed due to solder mask lift-off. Alcatel-Lucent has developed an MFG (Mixed Flow Gas) test method which allows for repeatable results. During studies with MFG it was demonstrated that assemblies constructed with wave solder fluxes containing rosin were much less likely to display creep corrosion, using any surface finish. Nils informed us on a post-plating treatment process which is an improved post dip which increases corrosion resistance, and emphasised that it is important that solder mask does not partially plug holes, and that a rosin based flux is used at all times.

Mustafa Özkök is the Global Product Manager for Selective Finishing Products at **Atotech Deutschland**. ENEPIG with pure palladium was his theme, and he described the advantages of using their new Universal Finish Solder Bond. Here the soft pure Palladium layer with ENEPIG results in better Au wire bonding performance, imparts better solder wetting, and for applications where no wire bonding is done, ENEP (nickel/palladium) can be used, thus eliminating the need for expensive gold deposition, and making ENEP a commercial and technical competitive alternative to ENIG. Solder joint reliability is excellent.

Edith Steinhäuser is working towards her PhD with **Atotech Deutschland** with her work on potential low-cost alternatives to palladium for activating electroless copper deposition. She described the steps in conventional electroless plating - conditioning, cleaning, etc., and wondered if palladium, which is expensive, is really the best reducing agent, where perhaps a hitherto unknown reducing agent, e.g. glyoxylic acid could be investigated, as well as formaldehyde. She explained that her work with both reducing agents had clearly shown that copper, silver or even nickel are potential catalysts for glyoxylic acid based solutions due to their high catalytic activity. However, an activator based on copper was less acceptable due to oxidation and instability problems, and here palladium has the advantage due to its inherent resistance to dissolution and oxidation, But palladium is expensive, so a new activator system is still needed, and it would seem that Mrs Steinhäuser has a little way to go yet awhile.

Martyn Gaudion of Polar Instruments spoke about the techniques for reduced time-to-market of high-speed flex-rigid impedance controlled PCBs with cross-hatched ground planes. Modelling of impedance is desirable as it reduces the number of prototype builds, and initially impedance models were relatively simple, but no equations existed for compensation. 2D field solvers did exist, but with flex growing fast, a new model was required that was easy to use. Taking data from 3 PCB manufacturers, Polar developed XFE (Xhatch Flex Enhancement) which uses traditional 2D field solvers but runs with multiple passes using a unique algorithm to correct for effects of flex over a wide range of typical controlled impedance structures. Initial results compare most favourably with cross section and measurement data from the 3 PCB partners. The XFE system, applicable to Polar's Si8000 PCB Impedance Solver and Si9000 lossy line field solver allows control over hatch pitch and width.

The ever-cheerful **Dr. Karl-Heinz Ognibeni of Coates Screen Inks GmbH** has been working with a screen printable screen coverlay to replace foils. Foils have high material and energy costs, whereas a screen printable coverlay has been proven to offer all the same attributes in terms of performance, with enormous savings, and customers have stated that 50% savings are perfectly possible. Using standard screen printing equipment, SunFlex SD has passed all the stress tests, flex tests, etc. They have also tried this material as an adhesive, in high Tg applications. Karl-Heinz explained how the

product was processed, quite simply by drying at 120°C after application, and then into the stress test press cycle, 1000 cycles at -40°C to +150°C, without any failure, Drilling tests showed no smear, and no decrease in drilling speeds, and with the help of the Fraunhofer Institute the samples passed the test of 168 hours at 85% RH, 85°C and again no failure after solder float tests. SunFlex can replace flexible coverlay, with impunity, and with huge savings in material and processing costs. Sunflex can also be used as a solder mask for high temperature application, where it passes all reflow tests, and can be laser structured and cut. Henry Ford would approve if he knew that it is also available in black.

Professor Dr. Werner Jillek of the George Simon Ohm University of Applied Sciences in Germany The number of steps required for ink-jet printed PCBs are so few, 5 in all, against 20 in conventional subtractive production, Inks are based upon nanoparticle diameters smaller than 50 nanometres, Inkjet printing is not a simple system as it might seem, the parameters are demanding,; paper used has to withstand sintering, and he demonstrated a working model of a tiny FM radio with components attached. Inkjet printing of etch resist on copper clad circuitry was also shown, and inkjet technology has the potential for integration of components on the PCB surface, as printed resistors, Inkjet can also be used for printing solder resist solder paste, printing multilayers It seems the potential of inkjet printing has not been realised yet. Swim or sink, he advised.

Uwe Altmann of Orbotech talked about solder mask exposure with LDI, as the solder mask road map showed the move towards finer line and spaces, 400 microns pitch, and registration accuracy of some 30µm. . Smaller solder dams, smaller annular rings, and smaller solder mask openings will need to be met, and here LDI can meet such demands. Scaling is either fixed or automatic, and he illustrated how it was possible to image down to 25µm, with small annular rings 35µm being achieved. Using conventional LPISM was described, with Sun Chemical being one of their partners, and the results were shown and looked excellent. Inner layers, outer layers and solder masks can now all be imaged by LDI. Throughput looks promising, with 80 prints per hour at 100mj/cm², and the system can be automated either stand-alone or in-line. The system lends itself very well to the quick-turn working practice of the modern PCB shop in Europe and elsewhere.

Hans Fritz of SAT Electronics Vertriebs GmbH in Germany, asked the question - which film imaging method is the best to-day? Well, material movement is a factor whatever system is used, and in a detailed technical paper Hans Fritz extolled the virtues of the Hakuto HAP1510ST for film mask scaling, which can scale up filmmask exactly to panel distortion, and to required dimensions. It has high accuracy (within 20µm), high productivity (120 panels per hour) and high resolution (30µm L/S). With 21 seconds per panel exposure time and capable of taking a panel size of 6510mm x 510mm, the Hakuto offers all the advantages of glassmask scaling with film.

Bernhard Steiner of IMPEX Leiterplatten GmbH in Austria spoke about his experience in high-tech drilling from the practical viewpoint. His company has five divisions, amongst which are a drill shop for drilling and routing, one which develops and manufactures measuring machines, one which looks after the sales and service of Schmoll, Bacher and LHMT machinery, and one for productivity and quality consulting. They have a 600 m² drill shop, fully air-conditioned, containing 14 single machines with 43 spindles, and 1 cube system with 10 module machine and 10 dual heads. This is a 24 hour drilling and routing service operating on 7 days per week. Their measuring system is called the proX3, which is a modular system with different measuring options, and can measure film objects, holes, pads, mask and image elements, contour elements and those with different depths, as well as laser drilled holes solder mask details, and holes and topographies. Equipped with a CCD colour camera and a laser depth sensor, it can measure thousands of elements in one second, and the speed of the scanner is so high that it can measure 100,000 holes in less than one minute. The accuracy is less than ± 5µ. Impressive information.

Schmoll Maschinen in Germany had sent **Kurt Polster** their Technical Sales Director to talk to us. For multilayer registration, the X-ray drilling machine is the answer, he thought. They also have a machine that can be used as a conventional drilling machine, and has an Optical Multilayer Registration facility contained within it. Kurt described how the drilling and registration of inner layers was performed, one side effect being that the machine determined and recorded where the pattern is, and where it should be. OIR is Optical Inner-Layer Registration, a system which carries out the calculation and drilling of new reference holes, as well as the complete drilling of analysed multilayer in the same panel. It can carry out the inner layer correction of each panel including the XY offset, shrink and stretch (dimension) and rotation.

Wolf Rex delivered the paper of Ties Muller of **HPTec** in Germany on mechanical machining of boards with insulated metallic substrate. This system is used more and more for metal core boards, as opposed to mechanical machining. This has some advantages, but it is slow and expensive. A standard routing machine is more efficient, but has low productivity, so Schmoll have a special machine for machining metal core boards which leaves the other systems standing. It uses a RZK 100 tool, which is new, and shows excellent results on routing. This 2.00mm tool operates well on all machines, and tool life is more than 120 metres before re-sharpening.

By holding the conference in Nürnberg, EIPC had permitted their delegates to avail themselves of the SMT/HYBRID/PACKAGING Show being held on the 7th 8th & 9th June, as well as making the JISSO International Standards Meeting available to those interested and involved parties. It was interesting to note that delegates came from no less than 13 different countries which reflects the international nature of the event.

The technical committee had selected some outstanding papers, and this was a most positive event, with spirits quite lifted by the close of play. The veritable minefield of technical difficulty in making printed circuits boards shows no signs of being cleared, but over these two days there was some excellent guidance towards a safe and profitable arrival.

John Ling
Editor.