European Institute of Printed Circuits

EIPC SPEeDNEWS

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NEWS FROM THE UK

Brian Haken

Brian Haken

Died 15/06/2015

It is with regret that one of our leading industry figures has sadly passed away. Brian was an inspiration to many of us and helped form the close ties and friendships that have bonded our industry together for many years.

The UK Printed Circuit Industry was flourishing in the 1980's. The Institute of Circuit Technology represented individual members and the Printed Circuit Association was the domain of corporate members. Brian had worked for E K Cole TV then Multitone Electronics and was the Sales Director at South East Printed Circuits. In 1987 Brian was instrumental in forming the PCIF which he led as Director from its inception until the merger with the FEI and later Intellect in 2000.

The PCIF was the lead federation representing UK printed circuit manufacturers, suppliers and assembly companies. Brian had a constant stream of new ideas and the success of the PCIF was a testament to his energy and drive. The regular quarterly meetings were eagerly attended and the annual conferences at Runnymede were always exceptional. One of the highlights was having Michael Heseltine as our after dinner speaker!

Brian helped steer the UK PCB industry to wider markets and the close ties with the IPC in the USA and JPCA in Japan meant the UK was respected worldwide and actively involved in a number of world conferences and international events.

Brian's golfing skills were not quite so exceptional though he had a knack of contributing to some very memorable times at our annual golf days.

It is particularly sad to note that Brian's wife Eileen also passed away a week before and our thoughts are with his family at such a sad time.

Brian's funeral is on Tuesday 23rd June at Southend crematorium, Sutton Road, West Chapel at 11.20 am. If you wish to make a donation to cancer research in his memory, then there is a link to the web site here: http://donateinmemory.cancerresearchuk.org/0006126

Richard Wood-Roe

A comment from the Editor

I had the great pleasure of working with Brian when I was working with Coates Circuit Products, and chaired the Suppliers Group within the PCIF for a few years. Meetings with Brian were always positive affairs, with great attention to detail, and he had an encyclopaedic knowledge of the industry, the milestones, those who worked within it, and those who, like him, were great contributors in both skills and effort.

Brian was a natural leader, and always convivial company, with admirable stamina when conferences hummed on long into the night. Brian had that gift of not being content with the reactive approach; his was an entirely proactive one, and his ability to see events unfolding was usually uncannily accurate.

To have known and worked with Brian was an honour, a pleasure, and an education, and I am indebted to him.

John Ling.

Institute of Circuit Technology 41st Annual Symposium

Dudley, UK, 3rd June 2015

ICT Technical Director Bill Wilkie excels in locating interesting and unusual venues for the Institute of Circuit Technology Annual Symposium. For the 2015 event, the 41st, he chose the Black Country Living Museum, an open-air museum of rebuilt historic buildings in Dudley in the West Midlands of England, home of the original Industrial Revolution.

From the smelting of iron with coal and the mechanisation of production with steam power, through the second industrial revolution that introduced mass production with electric power, followed by the digital revolution using electronics and information technology to automate production, we are now entering a fourth industrial revolution with development of the Internet of Things, a concept in which printed circuit boards are unseen but fundamentally essential components.

Welcoming a full house of delegates, Bill Wilkie opened the proceedings by acknowledging the enormous contribution over five years in office of retiring ICT Chairman Professor Martin Goosey, and introducing newly elected chairman Dr Andy Cobley.

The first technical presentation came from **Dr Darren Southee**, formerly of Brunel University and currently Programme Director of Product Design and Technology at Loughborough University. Speaking from a background of 15 years' experience of printing electronic devices using unmodified printing presses, he described recent work supported by IeMRC at Loughborough aimed at broadening the integration of printed power sources with electronic systems, determining the feasibility of making rechargeable energy storage devices using mass produced printed electrodes, and producing a demonstrator. His team had characterised electrodes produced by offset lithographic printing and new examples produced by flexographic printing using commercially available inks, and investigated the scope to combine them with various electrolytes to construct a range of supercapacitors. A supercapacitor needed high-surface-area electrode material, its resistance needed to be as low as possible to achieve high power and its energy storage was strongly affected by the electrolyte's electrochemical stability window. Trials with the new electrodes in 6-molar potassium hydroxide with a filter paper separator had given realistic electrical results, but there were issues regarding sealing and electrode wetting.

A solid-state version had been developed, by coating each electrode with a PVA gel and allowing it to dry, then gluing the two electrodes together using the same gel and allowing the assembly to partially dry before sealing. No additional separator was required. A stack of supercapacitors charged to 2.4 volts had been shown capable of powering a 1.6 volt LED for around 90 seconds. In a second demonstration, the printed electrodes were modified by adding an activated carbon layer and an ionic liquid was used as the electrolyte. The two electrodes were separated using filter paper and two supercapacitors were connected in series. In this combination, the supercapacitors could be charged to 6 volts, with a capacitance of around 0.5 Farad, and could light a wind-up torch for over a minute.

Independent business consultant and ICT council member **Francesca Stern** gave her outlook on the UK PCB and electronics industry. Her figures indicated that the value of global electronics production, excluding components, grew from $1.4 trillion in 2013 to $1.5 trillion in 2014, the main growth coming from Asia, with low single-digit growth in Europe and North America and a 5% decline in Japan. Of a 2013 European total of $154 billion, the UK share was about $13 billion, major sectors being instrumentation, radar and navigation and communications.

Looking at UK PCB production, in pounds sterling to avoid distortion by exchange rate fluctuations, there had been a slight decline from £139 million in 2012 through £136 million in 2013 to £130 million in 2014, with the main market sectors being industrial and instrumentation 36%, military and government 21%, communications 12% and civil aerospace 10%. Net imports of PCBs into the UK had risen from £41 million in 2012, through £54 million in 2103 to £75 million in 2014. She believed that growth in PCB production in the UK would overall be zero in 2015, although it would appear as low single digit growth because of the shrinking number of fabricators. All regions had peaked on their current growth cycles and she expected the next surge to be in 2017-18.

Because of other commitments, Alun Morgan, Chairman of the European Institute of Printed Circuits, was unable to attend the symposium and his paper on fire retardancy was presented by **Professor Martin Goosey**, who put his personal interpretation on certain points. He explained that flame retardants were chemicals which, when added to materials during or after manufacture, inhibited or suppressed the combustion process during heating, decomposition, ignition or flame spread. The presence of flame retardants in otherwise combustible materials had the effect either of preventing the fire from developing altogether or of slowing down the propagation of the fire and delaying the time to flashover so that people could escape. Annually in the EU there were more than 4,500 fatalities resulting from fires, accounting for 2% of all fatal injuries, and if occupants of a domestic dwelling fitted with working fire alarms were asleep upstairs when a fire started on the ground floor, they would have only about three minutes to escape.

Professor Goosey described the different classes of flame retardants and explained the physics and chemistry of how they worked. With specific reference to the halogenated flame retardant used in printed circuit laminates, the starting material was tetrabromobisphenol-A (TBBPA), which was chemically incorporated into epoxy resin during the manufacturing process. It was only when the resin was burned that bromine compounds were released by chemical breakdown, and inhibited the combustion process.

Unfortunately, there were widespread misconceptions about "halogens", and their perceived toxicity. In fact, halogens such as chlorine and iodine were essential to life, and so far as the end-user was concerned, a halogenated PCB material was no more than a cross-linked polymer that would not burn! The toxicology of TBBPA had been exhaustively studied. No evidence of risk to human health had been observed and there was no clear scientific justification for restricting the use of halogenated flame retardants. TBBPA was one of the first substances to have been registered under the REACH regulations, and was not listed as a "substance of very high concern" Neither was it listed as a restricted material under RoHS.

However, the fact remained that major multinational OEMs such as Apple and Dell were committed to eliminating brominated flame retardants and PVC plastics form their products. Non-halogenated alternative reactive flame retardants for epoxy resin included the phosphorus compound dihydro-oxa-phosphaphenanthrene-oxide (DOPO), aluminium trihydrate and aluminium monohydrate (Boehmite). Halogen-free laminates tended to be more expensive and more difficult to drill. However, they generally had lower thermal expansion, longer T-260 and T-288 times and higher Td temperatures, so might be better suited for multiple reflow processes and able to withstand higher reflow temperatures.

Dr Donna Palmer introduced the new EPSRC Centre for Doctoral Training in Embedded Intelligence (CDT-EI) at Loughborough University, of which she was the manager. The centre, jointly sponsored by the Engineering and Physical Sciences Research Council, industry and the university, with funding of £13.6 million, was the first of its kind in Europe and focused on high priority areas such as autonomous complex manufactured products and systems, functional materials with high performance systems, data-to-knowledge solutions such as digital healthcare and digitally connected citizens, and engineering for industry, life and health. Research in embedded intelligence addressed the challenges posed by the technical needs and requirements of end-users. Challenge areas included design for embedded intelligence, manufacturing of embedded or on-bedded devices, packaging and interconnection, software for data collection, and hard-soft integrative technologies, all converging through applications engineering. CDT students were funded for four years and the programme included technical and transferrable skills training as well as a substantial research element. The centre brought together diverse areas of expertise to train engineers and scientists with the skills, knowledge and confidence to tackle evolving issues and future challenges, and provided a supportive and exciting environment for students, creating new working cultures, building relationships between teams within the universities and forging lasting links with industry.

I**CT Chairman Dr Andy Cobley**, Reader in Sonochemistry and Materials at Coventry University and Director of the Functional Materials Applied Research Group, reviewed three research projects supported by the ICT.

The Eco-Innovation project MESMOPROC combined electrochemical reactor engineering with innovative ultrasound agitation to enable selective metallisation of microscale devices, components and printed circuit boards whilst eliminating repetitive photolithography. The conventional photolithographic method of patterning metal onto a substrate was a long, multiple step process, requiring many chemicals and a clean-room environment, and the mask could be used once only before it had to be stripped off. Electrochemical maskless patterning technology used a low metal concentration electrolyte and very small anode to cathode spacing. The 'mask' was placed on the anode, and ultrasound was used for agitation. The laboratory-scale reactor used in the initial stages of the project had been scaled up, plating trials were currently in progress at a PCB fabricator in the Czech Republic and a high-tech electroplating company in France, and the process was being demonstrated to potential customers and licensees.

A project for maskless metal patterning of non-conductive materials by electrochemical deposition in an external magnetic field was receiving pump-prime funding from Coventry University. The objective was to produce a disruptive, sustainable and cost effective technology for the metallic patterning of non-conductive materials by selective electroless plating using template of magnetised iron rods mounted behind the substrate to attract metal ions.

e-MINDS was investigating electrochemical processing methodologies and corrosion protection for device and systems miniaturization, through a COST action, COST being an inter-governmental scheme to open the European research area to international cooperation in science and technology. Dr Cobley explained that COST encouraged industry participation, and advised how small-medium enterprises could get involved.

Lunch was a less-than-formal event, which involved a walk to the museum's High Street and queueing for traditional fish and chips, cooked in authentic beef dripping by Hobbs and Son, served in newspaper with salt and vinegar and consumed while standing in the street!

Chip wrappers ecologically disposed of and greasy fingers washed clean, delegates returned to the conference room for the afternoon session, which began with an authoritative guide to the selection of PCB materials for LED lighting applications by **Les Round,** Technical Sales Manager at Spirit Circuits.

The PCB was an integral part of a modern LED luminaire, providing a convenient base for assembly and subsequent fixing of LEDs into the luminaire, thermal management of the LEDs, and an aid to power and light efficiency. LED applications fell into three main categories: low wattage / low density, mid power and high power, each of which required a substrate that balanced cost against performance. A typical low power / low wattage application was in ceiling-tile lights, accounting for large numbers of large-area single-sided PCBs on which there was a relatively low thermal demand. Low cost, flatness and high reflectance were fundamental requirements and these could be met by CEM1 material, which cost less than equivalent single-sided FR4 and had better flatness, although it needed to be selected carefully to ensure reflow compatibility. The finished surface required high reflectivity to maximise luminaire efficiency. This had opened up a market for specially formulated white solder resists and Round described test methods developed at Spirit for qualifying reflectivity

For mid- to high-power applications, the main requirement of the PCB was effective thermal management in order to improve efficiency and longevity. A wide range of IMS materials was available to meet most thermal demands. Materials could be selected based on cost versus performance, although customers sometimes specified particular proprietary grades. Spirit had evaluated more than 70 commercially available IMS material using their own testing procedures, and had produced a league table of thermal performance.

A simulated down-lighter test was used to compare high-specification IMS, traditional IMS, branded Chinese IMS and unbranded Chinese IMS. Only the unbranded Chinese material gave unsatisfactory results, and Round advised caution in selecting this type of product from data sheet values alone, without doing practical testing. He strongly recommended that the materials and panel sizes were selected as early as possible in the design cycle, and that designers used their PCB suppliers' product knowledge to best match materials to the specific requirements of the application: thermal performance, flatness, solderable finish and solder resist.

Ventec Europe Technical Support Manager **Ian Mayoh,** explained "what the FOD was going on", FOD being Foreign Object Damage. Having started by illustrating some extreme examples of aviation disasters, he focused on the growing awareness of foreign object damage in electronic devices, particularly in ultra-high-reliability applications, where critical failure could result in loss of life or have extreme cost implications. In the case of multilayer laminates, particularly in cores less than 50 microns thick, the avoidance of FOD was becoming increasingly critical and he referred to recent proposals by the European Space Agency to add an appendix on laminate cleanliness to the IPC-4101-D specification. Mayoh went on to explain the steps that Ventec had taken to establish a clean, quality-driven culture at all stages of their AS9100C-accredited integrated supply chain, from raw materials, resin processing and prepreg treating, layup and lamination, all the way through their fabrication and distribution operations. The company's fundamental policy was to manufacture quality into their products, rather than to inspect defects out, and as result of their investments and procedures they were now able to mass-produce dielectric layers of 30 microns and below to enable customers to build HDI constructions with full confidence in the cleanliness of the material.

Final speaker of the day was Dr Emma Goosey from MTG Research, with an update on the STOWURC project - Sustainable Treatment of Waste Using Recycled Chitosans. The requirement to remove low levels of metal pollutants such as copper and nickel from PCB manufacturing effluent could be achieved using ion exchange resins, but an alternative was to use waste natural products and it had been observed that chitin, present in crab shells, could absorb these metals. Disposal of crab shell waste from the food industry was expensive and subject to various legislation, so to use the waste from one industry to treat waste from another industry and to recover potentially valuable metals was an attractive proposition. Dr Goosey described how crab shells were prepared for use by first crushing and demineralising, then treating with alkali to convert chitin to chitosan, which was a more efficient absorbant, by de-acetylation. The resulting material had been shown to give consistent fast uptake of copper and a high rate of recovery from actual PCB manufacturing effluent. Ultimately, it was found that the copper could be desorbed into sulphuric acid to give an electroplating solution from which metallic copper could be recovered galvanically, and the metal-free chitosan could then be reused.

The Institute of Circuit Technology continues to grow its membership, and the Annual Symposium is a major occasion that attracts most of the leading names and faces of the UK PCB industry. This year's event was not only a platform for exchange of knowledge and ideas but another great opportunity for building networks and collaborative relationships.

Pete Starkey
I-Connect007 ***June 2015***