MANUFACTURING ADVANCED COATINGS FOR FUTURE ELECTRONIC SYSTEMS

Welcome:

The project is now in its final 6 months. This time will be spent testing solder joint integrity, wire bonds, bath lifetimes and on meeting industry standards.

Contents:

Issue 03 **Summer 2016**

Project N°: 102020

This project is co-funded by:

Innovate UK

MACFEST Project Update:

The project has completed industrial trials for a blind study to compare the MACFEST process to other industry coatings. The MACFEST project has chosen electroless Ni, immersion Pd, immersion Au coatings to be delivered from non-aqueous chemistries. The chemicals chosen have low volatility, and this promises multiple benefits over the current traditional processes. These benefits include:

- **Improved work place health and safety,**
- **Reduced evaporative losses from the plating baths,**
- **More stable bath chemistries and concentrations,**
- **Recovery of the chemistry for bath recycling**
- **Environmentally benign**
- **Disposal as non-hazardous material.**

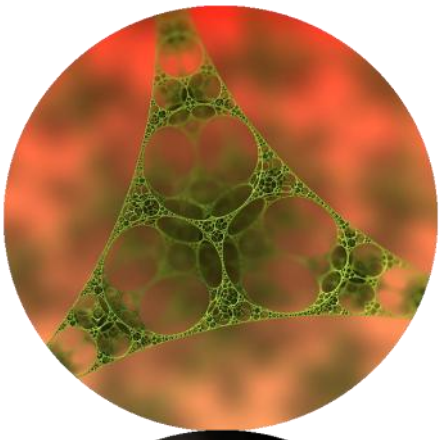
The MACFEST process and chemistry will deliver a step change in the production of high grade PCBs. The importance of these high quality, high cost and critical boards for the UK defence, security and aerospace industry is the elimination of black pad occurrences, improving reliability and quality for critical applications and use in harsh environments. The MACFEST process will help boost the future production and design of printed circuit boards that meet the developing needs of the Internet of Things and future packaging technology challenges.

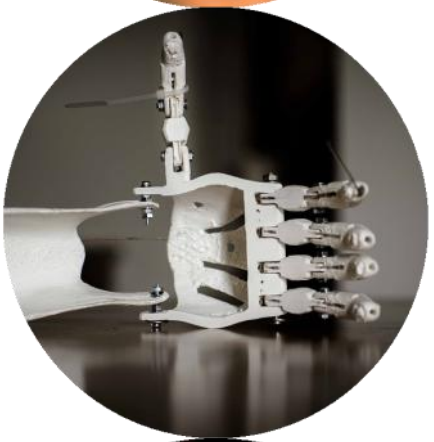
Key Enabling Technologies

Emma Goosey

Key enabling technologies (KETs) are labels given to technologies that have been identified as catalysers for societal and technology, innovation and growth. The European Commission considers there to be six main focuses for the development of new key enabling technologies. These include: micro and nanoelectronics, nanotechnology, industrial biotechnology, advanced materials, photonics, and advanced manufacturing technologies. These technologies are thought to be the building bricks, fundamental to a wider range of products and applications, each feeding into multiple different industries, value chains and developing sectors. These six KETs are universal tools, and by identifying these sectors, greater funding, resources and assistance can be provided to the representative industries to nurture innovation and research. Currently, these KETS represent 19% of total EU production, almost €1 trillion and over 3 million jobs. There are 187 KET centres across Europe, 11 of which are in the UK, they are designed to accelerate innovation, advanced products, process and services. The expected growths of these industries are between 5 – 16 % p.a., with the aim of adding over €400 bn to the EU economy, whilst supporting over 20 million jobs.

For European and UK businesses to remain at the forefront of global development, it is imperative that the region develops and owns leading technology, related intellectual property and has established manufacturing in these sectors. In turn, it is anticipated that the innovative growth will generate jobs, and growth within Europe, as well as addressing societal challenges. Additionally, the reason for identifying these KETs was to offer further support within the EU to nurture research and development in these areas to grow into marketable products. Often, R&D efforts in Europe are destined for the “valley of death”. In the UK, this is particularly true, where there is a difficulty in growing research into commercial applications. The academic and research community in the UK is globally impacting. But this does not translate to business where entrepreneurial success has been impacted by lack of financial support and high UK prices, compared to developing the ideas abroad. The KETs are known to be knowledge and R&D intensive, require rapid innovation cycles, high capital and highly skilled employment. Also, the lead times for innovation in these areas are significantly longer because of validation, industry acceptance, and testing, required to demonstrate the quality and lifetime (which are important for items used in critical and harsh environments (e.g. medical, defence, space).



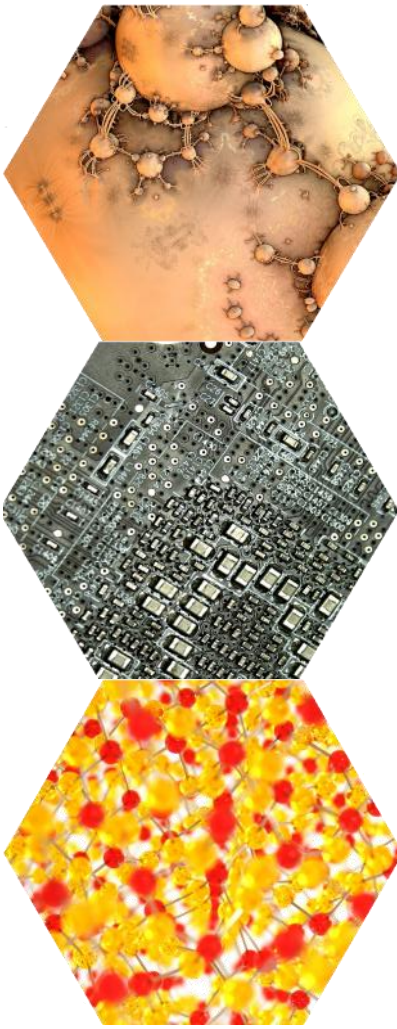


Global competition is intense, and the UK is being challenged by both developed and emerging economies. To support companies, it is important that the government provides funds for risky ventures and innovative ideas, in order to grow and nurture development. These KETs have been identified to be critical for Europe’s future global competitiveness by supporting both economic growth and societal challenges for future products and services

We are at a time where cross-cutting technologies are becoming a requirement, linking innate objects to the internet of things and connecting societies to each other, to networks and for communication between networks (e.g. autonomous objects communicating together). In this sense, the challenges of future developments and needs are increasingly difficult because of the required built in integration. There is a need for improved materials, composites and chemicals to adapt manufacturing techniques to develop improved characteristics, reduce sizes and generally create materials that can do more and be more.

Behind many of these KETs and their commercial implementation are electronics and the PCBs that form them and, on the other hand, are the KETs that will support innovative developments in PCB manufacturing (photonics, micro and nanoelectronics etc). The PCB and electronics industries are having to adapt to the internet of things, and demand for a step change in electronics in new scenarios and applications; providing boards with greater functionality, reliability, production speed and reduced size and weight. The capabilities of the electronics manufacturing sector within Europe will shape, not just the economy and societal development, but also the health industry, and European defence and security. The micro and nanoelectronics sector currently provides 1.4 million jobs across Europe.

Electronics market growth is potentially huge, with a predicted compound growth of over 8% p.a. in the next 5 years accounting for some £210 bn increase in the electronic contract manufacturing industry. It is, therefore, critical that EU industry and manufacturing partakes in this development, by offering new innovations, superior quality and improved durability, whilst adhering to the ever decreasing sizes (developing from micro to nano electronics) with the UK being the third largest employer (despite a slip in the rankings following the recession), following Germany and France. For all the KETs, the UK remains in the 3rd or 4th position for employment compared to the EU 28 (although Germany is ranked first for employment in all 6 sectors). Despite the 'valley of death', the UK has had a considerable increase, since 2011, in the six KETS including electronics production. Out of the full 28 EU countries, the UK came 7th for production, trade and 6th for technology. Whilst the UK performs well for most KETS, since 2007 it has had a constant decrease in performance for advanced manufacturing, which is likely to continue whilst the Brexit deal is organised. This may impact the productivity of the remaining KETs, particularly if exports decline following a departure from the EU single market. The EU still leads in power electronics, high frequency devices and micro and nano-electrochemical systems (MRS 2011). So there is an opportunity to remain at the forefront of the global industry. Key areas of development for the PCB industry include:



- Thin film transistors on plastic substrates (enabling flexible electronic circuit designs)
- Interconnect technologies
- Decreasing size and increased functionality per unit area
- Stacked assemblies (to generate surface area for component mounting)
- Embedded active and passive components
- Buried capacitive layers to ensure power distribution
- Fibre optic transmission lines
- System on Package (thin film components on package substrate)
- Increasing demand for high density interconnect (HDI) and Rigid-Flex technology
- 0.3 mm pitch BGA for next generation microprocessors and FPGAs
- Laser direct imaging which is more suitable for HDI components
- Laser microvias created with picosecond pulses
- Substrates that support faster data transmission rates and higher frequency (including ultra-low dielectric loss)
- 2.5D thermoforming of circuits
- 3D components
- High frequency meta–materials
- Environmentally friendly paper based boards.

.

To support these developments, more innovative production and validations processes will be incorporated, like laser microvias using picosecond pulsing to minimize thermal effects, better automated optical inspection for improved quality assurance, and developing initial board designs in 3D. Whilst the KETs describe the direction of industries' future developments, individual companies are looking to remain competitive through reducing manufacturing costs, improving reliability, speeding up production and further miniaturization.

Future Developments

These changes in the PCB market are to support developments such as a 5G wireless service, wearable electronics, dual band balanced antennas, wireless microelectronics and communications, electronic sensors and biosensors for healthcare, implantable devices, autonomous devices and many other applications designed to meet societal challenges.

Coupled with fast growing technologies, the micro and nano-electronics KETs have produced over 80 patent applications in the past decade, with the largest number being generated in Eastern Europe and Northern Italy. For SMEs, the use of KET centres across the EU are supposed to speed up the commercialisation of their innovative ideas. Additionally, there are new EU finance opportunities for SMEs from the European Commission, European Investment Fund and European Investment Bank for SME financing. For the UK, changes to Innovate UK and Brexit funding for KETs is likely to be embedded in the 'emerging and enabling technologies' calls, though it is likely that KETs will be applicable to all four funding areas including 'health and life sciences', 'infrastructure systems' and 'manufacturing and materials' for 2016/2017 innovation funding.

PCB and Electronics News:

- India to implement producer responsibility legislation for electronics to help reduce environmental damage. The Environment Minister plans to mandate an initial collection target of 30% rising to 70% by 2023. This includes fluorescent lamps, as well as typical consumer products. In 2014, 1.7 M tonnes of electronic waste was produced in India. The aim is to prevent mercury, heavy metals, flame retardants and other chemicals from contaminating the environment through leachates.

- The international conference NANOFIS, 2016, was held last month in Austria. The conference aimed to address important topics and advancements in the Micro and nano electronics industry. The key message that arose from the conference was that Europe should focus on its core competencies of smart system development and system integration. Additionally, the integration of More-than-Moore (MtM) devices on boards should be supported with European Industrial Policy, to support competition with the USA and Asia.

- The EEV blog Electronics Resource Wiki is a useful blog listing all aspects of electronics and associated electronic design. There are resource pages, which include electronics people, blogs, twitter, forums, tutorials, books, manufacturers, assemblers, CAD programmes, and many more links to tools, services and the electronics industry. www.eevblog.com/wiki/index.php?title=Main_Page

CONSORTIUM FOCUS:

Since it was founded in 1994, A-Gas Electronic Materials has risen from humble beginnings to become a leading distributor and supplier within the semiconductor, printed circuit board and industrial metal finishing sectors. The firm has enjoyed impressive growth in recent years, and following a major investment in state of the art new premises has now set its sights on achieving seven-figure annual profits by 2020.

Founded in 1994 by Alan Billinghurst, the company was initially headquartered in a small 1,500 sq ft unit on Summers Road in Rugby. Alan's enterprise was staffed by family and a small number of business associates, and acted predominantly as a distributor for his former employers, Coventry-based Shipley. Originally known as Chestech Limited, the company was formed with a remit to work with small and medium sized customers, and enjoyed steady growth in its early years. However, its focus was to change significantly when Shipley was taken over by Rohm and Haas, who took the decision to focus on the Asian market, leading to a reduced presence in Europe.

This led to an enormous opportunity for Chestech to take over many of Shipley's services, including the manufacture of circuit boards and electronic finishing, with a new four-strong division assembled to handle the new responsibilities. The growth of the business saw it bid farewell to its original Summers Road home when it acquired a new and larger unit at Hadrian's Way. It didn't take long for the business to expand further through the acquirement of the unit next door, taking the size of the new base to more than 7,500sq ft. As Chestech became an increasingly recognisable name within the sector, it soon caught the attention of potential investors and in 2008, was sold to A-Gas International. Recognised as a leading name in refrigerants, as well as industrial and special gases, the acquisition of Chestech saw A-Gas move into a new sector that was quite distinct from its existing core portfolio of businesses.

The newly renamed A-Gas Electronic Materials soon transitioned from making a £35,000 loss in 2008, to a £27,000 profit a year later. By 2010, this had increased to £140,000. The business has continued to enjoy encouraging profit growth each year since then, achieved through an enhanced focus on careful financial management, and minimising overheads. A-Gas Electronic Materials has now outlined its vision to achieve profits in excess of £1million within the next five years. Central to this has been securing an investment of £300,000 from the A-Gas board, which has funded the firm's new 20,000 sq ft premises. Offering a great deal more space to enable plans for expansion, the new base has been carefully designed to the firm's specifications, and includes a host of state-of-the-art functions to enhance the quality of its products and the services it offers to customers. Among them is a new cold storage room, which is temperature controlled at 10 degrees, with 50% humidity. This is an important investment for the business, as it allows for dry film to be stored in a way that preserves its optimum quality, to ensure customer satisfaction. The new premises has also seen a significant extension to the firm's laboratory capabilities, including new inductively coupled plasma technology, which enables staff to identify metal impurities at the lowest levels (ppb).

A-Gas Electronic Materials has built its reputation on its relationships – both with its suppliers and customers. Today, the company maintains a strong partnership with Dow Electronic Materials, one of the biggest global chemical companies, as well as with many of the UK's largest manufacturers. Speaking about the firm's new growth plan, Jonathan Sellars, Managing Director of A-Gas Electronic Materials, said: "From its origins as a family business when it was formed in 1994, our company has maintained the ethos of a small independent throughout the growth we've enjoyed since. "Our point of difference remains the combination of excellent customer service with in-depth technical knowledge. Our staff are always well placed to offer informed and expert advice, ensuring a solution that meets the need of every customer." Jonathan continued: "Through the fresh investment in the company, we are now set to accelerate our growth. Having become a leading distributor in the UK and Ireland, we're taking our first steps into overseas trading, and we're confident that this will play a key role in helping us to achieve our targeted profits."

With 21 years of success and consistent growth behind A-Gas Electronic Materials, it remains to be seen what the coming years will bring. However, given the speed of transition since the loss-making return of 2008, coupled with the unparalleled, state-of-the-art facilities now at its disposal, few would bet against the business achieving its '2020 vision' of a million pounds of profit.

RECENT DEVELOPMENTS IN THE IONIC LIQUID SECTOR

The ionic liquids market is forecast to exceed $2 billion (USD) by 2022 (Global Market Insights Inc.) because of their demand in pharmaceuticals, electronics and the chemicals industry. With over a quarter of the market share being dominated by catalysis /synthesis applications, the pharmaceutical use of ILs is anticipated to rival this market share by 2022. This is believed to be a result of the REACH Directive and EPA actions aimed at reducing VOCs in the environment and work places (Clean Air Act). Whilst these chemicals are noted to be 'green' because of their low vapour pressures, their toxicity to other parts of the environment must be noted and regulated (such as the persistence of N-alkylpyridinium in soils and water).

The production of ionic liquids over the next six years is predicted to rise to over 50,000 tons, an increase of 400% from 2014. Key companies to watch are Solvionic, BASF, IOLITECH, Coorstek, TCI, Strem Chemicals, Merck and Scionix according to the GM Insights Report. Big gains are expected from China which is aggressively trying to target their pollution issues and air quality.

UPCOMING DATES:

17th - 19th August 2016	Electrochem 2016, University of Leicester, UK.
21st - 26th August 2016	Int. Soc. Electrochemistry Annual Meeting, The Hague, Netherlands.
16th September 2016	Waste treatment of Batteries Using Ionic Liquids, C-Tech Innovation, Chester, UK.
22nd - 24th November 2016	European Nanoelectronics Forum, Rome, Italy