ULTRAWIRE 2019 WORKSHOP

Workshop on Commercialisation of Ultra-conductive Composite Materials

Final Report v2.0

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10th & 11th July 2019

Meeting Venue: *The Chancellor's Centre*
Wolfson College
Barton Road,
Cambridge, CB3 9BB

Dinner Venue*: Isaac Newton Suite*
Hotel Hilton Cambridge City Centre
20 Downing Street
Cambridge CB2 3DT

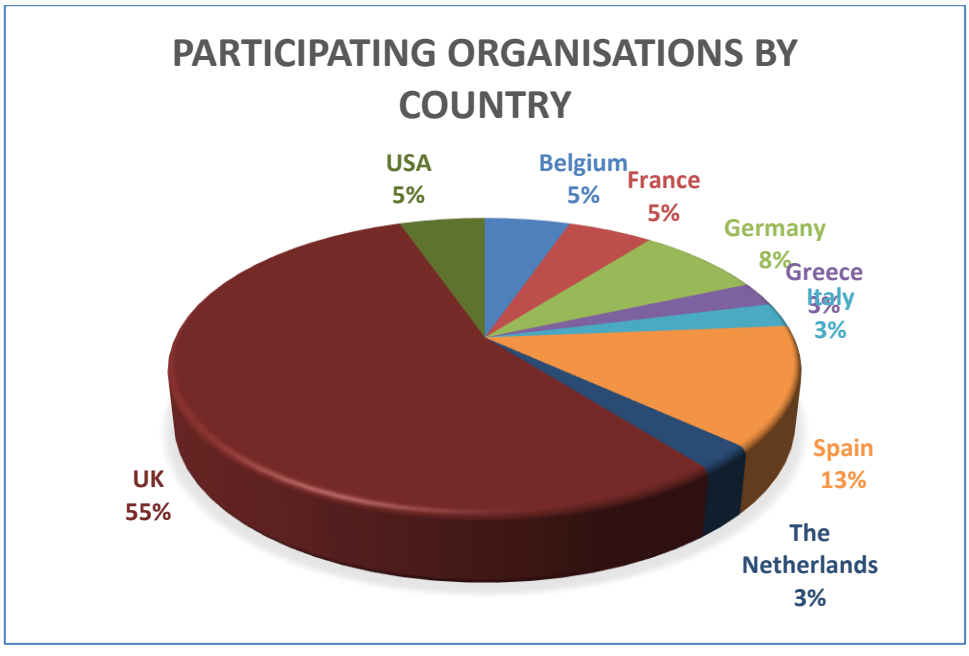
Organised by:

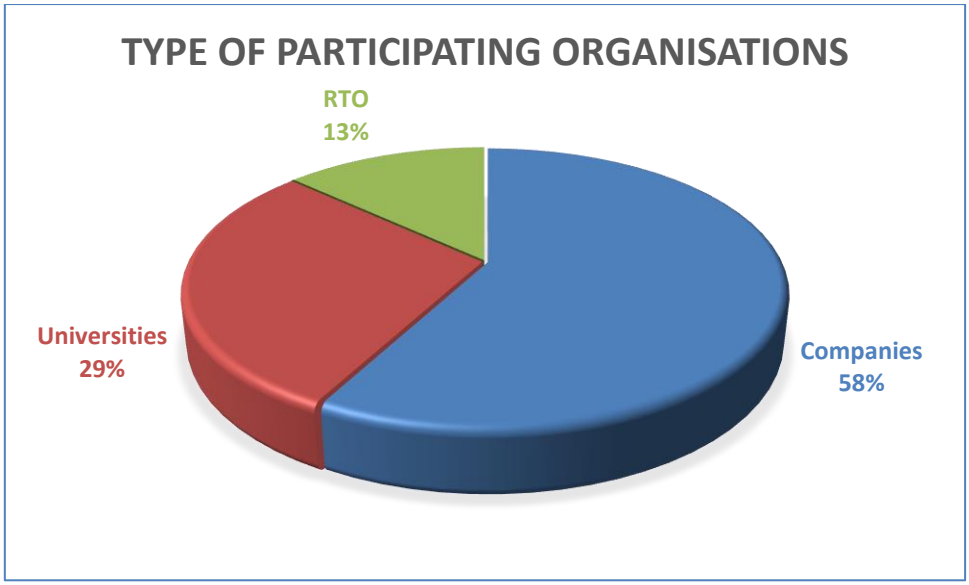
CAMBRIDGE NANOMATERIALS TECHNOLOGY LTD

Contents

Summary

Cambridge Nanomaterials Technology Ltd organised the **UltraWire Workshop 2019** in order to support commercialisation of ultra-conductive materials and development of nano-carbon and metal composites-based technologies for a number of applications, including electrical energy transmission and transport, by bringing together technology development leaders and industrial end-users. The **UltraWire 2019 Workshop** was an opportunity to follow UltraWire project research and learn about progress in development of nano-carbon wire technology. It was also a platform to exchange experience for all technology developers in industry and researchers in academia, working on nano-carbon and metal composite materials. This year, we have used the opportunity to link the workshop with activities related to use of nano-materials and metal composites in additive manufacturing, and a number of speakers related to this topic will be presenting on the second day of this workshop **(nanoMAT^{3D})**. The **nanoMAT3^{D}** (*Nanomaterials for 3D printing*) Workshop has been designed as a platform to support nanomaterials and additive manufacturing producers, application developers and end-users, in development of technologies based on use of nanomaterials for 3D printing. The aim is to identify commercialisation barriers and opportunities and facilitate development of the supply chain. Around 50 people participated in this workshop during both days.





Feedback from participants

"It was a great pleasure to meet you both All the organization was perfect, thanks! The discussions were very interesting .."

R&D – Direction
RTE

"Thanks a lot for all your attention during the meeting. All was perfectly organized and we could attend to very interesting talks."

R&D Engineer
ArcelorMittal

"Thank you very much for the great organization of the conference. It was a very nice experience."

Senior Project Leader
TWi

"Thanks again for putting together a fantastic conference, thoroughly enjoyed it and there were some good partners involved to discuss opportunities with..."

Senior Project Engineer
Haydale Composite Solutions Ltd,

"First of all, I wanted to thank you for the organisation of this event, it was perfect! ."

Research Associate
IMDEA Materials Institute

List of participating organisations

Organisation	Country
Additive Industries b.v.	The Netherlands
Advanced Technology Institute - University of Surrey	UK
Airbus Defence and Space	UK
ArcelorMittal	Spain
Argonne National Laboratory	USA
ARUP	UK
Aurubis	Belgium
Bridon-Bekaert	UK
Brunel Composites Centre	UK
Cambridge Graphene Centre - University of Cambridge	UK
Cambridge Nanomaterials Technology Ltd.	UK
Cametics Cambridge Advanced Metals	UK
Chord Electronics Limited	UK
Coatema Coating Machinery GmbH	Germany
E.G.O. Elektro-Gerätebau GmbH	Germany
Energy Safety Research Institute (ESRI)	UK
Eurecat	Spain
Haydale Composite Solutions Ltd	UK
HP Labs	UK
IMDEA Materials Institute	Spain
Imperial College London	UK
Innovation in Research and Engineering Solutions -IRES	Belgium
Leitat Technological Centre	Spain
MBDA	UK
Mitsubishi Heavy Industries Europe, Ltd.	UK

Nanoscience Centre - University of Cambridge	UK
National Technical University of Athens	Greece
National University of Singapore- Graphene 3D Lab	USA
Prysmian Group	Italy
RTE	France
Senergy Innovations	UK
SH Wire - Schwering & Hasse Elektrodraht GmbH	Germany
Teknan Conductors	Spain
Trackwise Designs	UK
TWI	UK
UCL	UK
University of Cambridge	UK
University of Strasbourg, CNRS	France

UltraWire 2019 Workshop

Agenda UltraWire 2019 Workshop

Day 1

Date: 10th July 2019
Venue: Gatsby Room
Wolfson College, Cambridge

14:00 *Arrival and registration*

14:15 **Dr Bojan Boskovic**, CEO, Cambridge Nanomaterials Technology Ltd

Welcome and Introduction to the UltraWire Workshop 2019

14:30 **Dr Marek Burda,** Director, Cametics - Cambridge Advanced Metals Limited, UK

Title: Development and commercialisation of nano-carbon enabled products.

An overview of Cametics & Aurubis research and development activities involving nanomaterials, such as graphene and carbon nanotubes, as to create a range of novel enabling products. Cametics is an R&D enterprise born out of the University of Cambridge. It was founded in 2014 by Prof. Krzysztof Koziol and Dr Marek Burda with the mission of bringing to the market innovative solutions in the field of advanced materials, such as nano carbons, metals and polymers. Aurubis is part of a leading global copper group, engaged in the business of producing high purity, high quality copper from copper concentrates and recycling materials, destined for various industrial applications. Initial contact and collaboration between Cametics founders and Aurubis has been established in the UltraWire project funded by European Commission to develop novel nanocarbon- copper conductors, and has been followed further after the end of the project. A collaboration of Cametics and Aurubis was formed to bring the great ability of nanomaterials to the copper market. The expertise of Cametics in the field of carbon nanomaterials and Aurubis' specialty in copper products led to a productive scientific research and development project. This work resulted in an innovative approach to improving copper bus bars. By implementation of a nano-enabled coating, the current carrying performance of the copper was observed to be greatly improved, thus creating an industrially novel, high value product. Additionally, other impressive properties of the coating were determined, further widening the scope of this technology. AmpaSHIELD coating products are at the forefront of the nano-carbon revolution and are one of the select few advanced material products which are available and used on an industrial scale.

15:00 **Dr Atif Aziz,** Nanoscience Centre, University of Cambridge, UK

Title: Carbon nanotubes/copper composites and their applications

Copper (Cu) is one the most commonly used conducting metals. Availability and the excellent electrical and thermal conductivities of Cu are the primary reasons behind its dominant position in the industry. Recent development in nanotechnology however, have provided new materials which possess the potential to surpass Cu. Among these, carbon nanotubes (CNTs) stand out on the basis of their high electrical and thermal conductivities, low density, abundance of precursor materials and supreme mechanical properties. Since Cu atoms do not easily attach on CNT surface, it has been very challenging to make CNT/Cu composites. In this talk I will discuss about nanoscale CNT and Cu composite where we have used different synthesis methods for coating individual CNTs with copper. These composites not only have a potential for making next generation electrical wires but can also be used as power storage devices like super capacitors.

15:30 *Coffee break*

16:00 **Prof. Andrew R. Barron,**

Title: Angular and overlap dependence of conduction between carbon nanotubes of identical chirality and diameter: Towards increased CNT fiber conduction

Measurement of the angular and overlap dependence of the conduction between two identical carbon nanotubes (CNTs), with the same diameter and chirality, has only been possible through theoretical calculations; however, our observation of increased resistance adjacent to the junction between two CNTs facilitates such measurements. Since electrical resistance was found to increases with increased diameter ratio, applying 10 V to one of dissimilar diameter CNTs results in cleavage at the junction. Manipulation of the resulting identical CNTs (created by cutting a single CNT) allows for the direct measurement of the angular and parallel overlap conduction. Angular ($13<\theta<63°$) dependence shows two minima (22° and 44°) and a maximum at 30°, and conduction between parallel CNTs increases with overall tip separation, but shows a sinusoidal relationship with contact length, consistent with the concept of atomic scale registry. Understanding the interaction between metal contacts and carbon nanotubes is of vital importance if efficient device operation is to be achieved. Here we have coated tungsten probes with copper and chromium and investigated nano contact transport into multi-walled carbon nanotubes both experimentally and in simulation. The probes where used to carry out STS and nanoscale 2 point probe while a DFT model was constructed to understand the contact formation. It has been found that copper contacting to multi walled carbon nanotube results in a high density of state at the Fermi level which contributes states to the conduction band. It was also observed that the density of states also increased when chromium and tungsten probes were contacted to carbon nanotubes, however the density of states also shifted to the valence band resulting in a decrease in charge carriers and demonstrated an increase in resistance when compare to the copper probe. These results suggest that copper tip should be use hen carrying out intrinsic conduction measurements on carbon nanotubes and explains the ultra-conductivity of copper-CNT composites.

16:30 **Dr María Vila Santos,** IMDEA Materials Institute, Spain

Title: Carbon Nanotube Fibres for electrical cable usage

The global necessity for electric energy and its effective transfer and transformation is quickly increasing, and any advance in this field of technology is surely, of great interest to industry, economy or environment. This rising need present new challenges in terms of materials fabrication, integration into multifunctional structures, and operation under harsh mechanical conditions. A key enabling technology to address some of these challenges are fabrics of nanocarbons. They combine the conductivity and toughness of steel, superior electrochemical stability than metals, the density of plastic and are already produced industrially. In particular, carbon nanotubes fibres assembled as cords, are potential candidates for the next generation of highly conductive electrical wires. These wires are lightweight materials with high mechanical performance, lower costs and a minimized ecological footprint. This presentation will discuss the current progresses in using this technology for integrated conductors and current collectors used in ligther supercapacitors and lithium ion battery electrodes outperforming commercial comparators.

17:00 **Dr Simon King,** Advanced Technology Institute (ATI), University of Surrey, UK

Title: Tube-to-Tube Targeted Carbon Nanotube Soldering

As they cannot be grown to infinite lengths, to fully utilise the outstanding electrical properties of individual carbon nanotubes (CNT) on the macroscopic scale, CNTs must be aligned and inter-connected, removing the detrimental tube-to-tube resistances. Through an aligned-fibre electrospinning process, CNT-loaded-polymer solutions can produce large scale sheets (0.8x1.2m) and long wires (up to 1.2m) of aligned CNTs loaded nanofibres, where the CNTs can then be easily thermally recovered without introducing damages. Using just a simple annealing process, without any tube-to-tube soldering techniques, measured specific conductivities (conductivity per unit weight) were still measured as at least 100x more resistive than a comparable copper wire. To overcome the tube-to-tube resistance responsible for these limitations in electrical performance, we demonstrate the utilisation of the CNTs natural joule heating to selectively solder the CNT tube-to-tube interconnects (see Fig. 1). As a result, we enhanced the CNT wires electrical conductivity to reach a specific conductivity as low as 0.4x that of a comparable copper wire, and a bulk conductivity of 2.6x106 S/m.

17:30 *End of 1st day meetings*

19:00 *Dinner at Hotel Hilton Cambridge City Centre*




Day 2

UltraWire/nanoMAT^{3D}

Workshop on Nanomaterials for 3D Printing

Date: 11th July 2019

Venue: Roger Needham Room –

Gatsby Room coffee breaks & lunch

Wolfson College, Cambridge

09:15 *Arrival and welcome*

10:00 **Dr Bojan Boskovic**, CEO, Cambridge Nanomaterials Technology Ltd

Welcome and Introduction to the Nanomaterials for 3D Printing 2019 Workshop

10:30 **Mark Bowers,** ARUP, UK

Title: Development of metal and cement 3D printed applications for construction industry

An overview would be given of the 3D printing projects related to construction industry applications and activities related to use of nanomaterials in ARUP, including presentations of recent 3D projects, such as:

1) 3D printed house in Milan (https://www.arup.com/projects/3d-housing-05),
2) 3D printed metal bridge in Amsterdam, the MX3D bridge (https://www.arup.com/projects/mx3d-bridge?query=3d%20print)

11:00 **Dr Elena Polyakova**, Senior Research Fellow, National University of Singapore - CEO, Graphene Laboratories, Inc (Graphene Supermarket), USA

Title: Critical Overview of Performance of 2D Materials and Composites

There is a frenzy of commercialisation efforts surrounding graphene and other 2D Materials. Many "graphene" products have been recently introduced. In many cases, there is no clear evidence that the addition of graphene to the polymers results in meaningful improvement of the performance of the composite. This presentation will provide a comprehensive overview of the current state of graphene research and give a clear comparison of graphene composites with commercially available materials. Further, the potential advantages of graphene composites for 3D Printing will be discussed.

11:30 *Coffee break*

12:00 **Dr Elias P. Koumoulos,** Innovation in Research and Engineering Solutions –IRES, Belgium

Title: Challenges of materials data management in additive manufacturing

12:30 **Harry Kleijnen,** Key Account Manager, Additive Industries B.V. Netherland

Title: "Accelerating Additive Manufacturing with process automation and integration."

Today's additive manufacturing production processes are characterized by many separated process steps requiring intensive manual labour and complex planning processes. For series production of parts this way of working will be too costly and is prone to errors, jeopardizing yield and overall equipment efficiency. In his presentation Harry Kleijnen will elaborate on Additive Industries vision and solutions for integrated and automated additive manufacturing. In addition, he also will present the environment to for the end-user to monitor Overall Equipment Efficiency as driver for continuous improvement in an end to end additive manufacturing process environment.

13:00 *Networking Lunch & exhibition*

14:30 **Dr Yarjan Abdul Samad,** Cambridge Graphene Centre, University of Cambridge, UK

Title: A novel graphene foam for low and high strains and pressure sensing applications

Since the successful realization of two-dimensional (2D) graphene, it has been desired to form a connected, three-dimensional (3D) structure of graphene so as to exploit its extraordinary thermal and electrical properties. We are reporting the formation of free-standing graphene

foam (GF) via a novel two-step process, in which a polyurethane (PU) foam is first dip-coated with graphene oxide (GO) and subsequently the dried GO-coated-PU is heated in nitrogen atmosphere at 1000□C. During the pyrolysis of the GO-coated-PU, GO is reduced to GF whereas PU is simultaneously decomposed and released completely as volatiles in a step wise mass-loss mechanism. The GF formed has tunable density, shape and scalability and possesses electrical conductivity as high as 160 S/m. Morphology of the formed GF conforms to that of the pure PU foam as indicated by the scanning electronic micrographs. Mechanical tests of the GF under compressive loads demonstrate that its mechanical behaviour is similar to that of other cellular solids such as ceramics. Polydimethylsiloxane (PDMS) was successfully infiltrated inside the GF without effecting it's electrical properties. Some photographs of the GF and the GF-PDMS composite are shown in Figure 1. The GF-PDMS composite was tested for it's pressure and strain sensing capabilities. It is shown that a 30% compressive strain changes resistance of the GF-PDMS composite to about 800% of it's original value. The effect of GF density on it's pressure/strain sensivitiy is also studied, and it is found that a lower density GF results in a GF-PDMS composite of better pressure/strain sensitivity. Since density of the formed GF is tunable, therefore, the pressure/strain sensitivity of the GF-PDMS composite is also tunable. Finally, it is also demonstrated that the GF-PDMS composite sensor is sensitive enough to measure the human blood pressure and pulse rate when worn as a wrist band. Therefore, using this composite sensor, a wrist band can be created which measures blood pressure, pulse rate and other derived biomedical data without any input energy.

15:00 *Coffee break*

15:30 **Joe Stallard,** Department of Engineering, University of Cambridge, UK

Title: The Properties of Direct-Spun Carbon Nanotube Mats

The walls of individual carbon nanotubes (CNTs) possess extraordinary properties. With tensile strengths of >100 GPa, a Young's modulus of 1 TPa, and high thermal and electrical conductivity, their performance has long aroused interest in the development of materials with CNTs as their primary constituents. The modulus, strength and electrical and thermal conductivity of macroscopic CNT materials such as CNT mats, fibres and CNT-polymer composites varies over several orders of magnitude. Their behaviour is highly sensitive to microstructure, composition, and method of manufacture. The role of microstructure in governing the properties of direct-spun carbon nanotube mats is investigated. The mechanical and electrical properties of a commercially available direct-spun carbon nanotube mat are measured. The mat microstructure is comprised of an interlinked random network of nanotube bundles, and possesses a small degree of in-plane anisotropy. Mechanical testing reveals that the mat's specific strength and stiffness is orders of magnitude below that of individual CNTs according to literature, and tensile tests performed with scanning electron microscopy reveal the origins of the mat's mechanical behaviour. Modification of the mat microstructure by polymer infiltration and axial stretching enhance the specific modulus and strength; the source of these improvements are explained through experimental observation and micromechanical modelling .

16:00 **Christine Boyle** MBE, CEO Senergy, UK

Title: "Senergy Solar Thermal Nanocomposite Panels from Concept to Commercialisation"

Solar Thermal is a renewable energy that is 70% efficient which far exceeds Solar PV which is only 18% efficient. It also produces the lowest carbon emissions and is easily generated on site

and it has the potential to become a reliable source of energy for heating and cooling space in the future. However, to date solar thermal energy collection systems made from glass copper and aluminium have been expensive and the initial investment has been cost prohibitive. There have also been challenges around the architecture and appearance of the systems. The Senergy business and product idea was conceived by Christine Boyle MBE, with almost 20 years running her commercial roofing company Christine recognised the potential for building integrated solar. Unlike current thermal panels that are made of glass, copper and aluminium Senergy panels are 100% polymer plastic, this makes them 50% less expensive to both manufacture and install than current metallic panels on the market. The Senergy panels benefit from the advantages of the polymer materials and incorporate carbon nanotube materials that enhance the thermal performance and mechanical strength. The panels are also embedded with low cost sensor and information technologies. This digital integration provides an IOT/IQT platform ensuring the energy supply is more efficient and the building owner has greater control. These advantages address the challenges that have hindered the roll out of this form of renewable energy. Bringing together expert roofing and polymer manufacturing companies alongside leading academics in the nanocomposite field, Senergy plan to leverage the innovative and commercial opportunities they have identified. What are the opportunities and barriers for large-scale cost-effective production?

16:30 Discussion

Facilitated by **Bojan Boskovic**, CEO, Cambridge Nanomaterials Technology Ltd

- Commercialisation opportunities and challenges for use of nanomaterials in 3D printing applications
- Advanced materials data security issues related to additive manufacturing applications and development of Industry 4.0

UltraWire 2019 Workshop – Speakers

Dr Marek Burda *(Speaker)*
Cametics
Cambridge Advanced Metals Ltd

Dr Marek Burda is a co-founder and Managing Director of Cametics Cambridge Advanced Metals Limited. Marek is responsible for representing the company to major customers and professional associations, building and maintaining research policy of the company and directing strategy towards the profitable growth and operation. Marek is leading the Company's Team in research, development and production of composite and hybrid products utilizing both classic and nanostructured materials. He holds a PhD in Materials Science and completed PostDoc research position at Department of Materials Science and Metallurgy, University of Cambridge, focused on development of Ultra Conductive Copper-Carbon Nanotube Wire. Marek is inventor of set of patented soldering alloys (C-Solder) which consist innovative & unique solution for bonding carbon-based components to other carbon or metal components.

Dr Atif Aziz *(Speaker)*
Senior Research Associate
The Nanoscience Centre
University of Cambridge

Dr Atif Aziz is a senior research associate at the Nanoscience Centre, University of Cambridge. His area of research is studying the physical, electrical and mechanical properties of nano materials and nanoscale devices. At present he is working on Carbon Nanotubes and metal composites in particular copper and functional nanofibers. He did his PhD from Cavendish Lab, University of Cambridge and had been working as a research associate at the Materials Science Department, University of Cambridge. Before his current job, he was an experimental office at the Lancaster University, where he setup a nanofabrication facility for Quantum Technology Centre and had been a manager of the Cambridge Graphene Centre.

Prof. Dr. Andrew R Barron *(Speaker)*
Director
Energy Safety Research Institute (ESRI)
Swansea University

Professor Dr. Andrew Barron is the Sêr Cymru Chair of Low Carbon Energy and Environment and Professor Emeritus of Chemistry, Materials Science and nano engineering at Rice University. Research in the Barron Group is currently aimed at the development of rational molecular design approach to materials synthesis, with an emphasis on the leap from synthesis to application of nano-based materials. In 2013 he Founded the Energy safety Research Institute at Swansea University. Areas being investigated include: carbon capture, utilisation and sequestration, green energy and power transmission. He pioneered the catalytic approach for the amplification of SWNTs that may be likened to the polymerase chain reaction for DNA and he has recently developed techniques for the measurement of electrical properties of both individual CNTs and their bundles. Professor Barron created the first educational programs at Rice to span the Schools of Science, Engineering and Management, and is a co-director of the Rice Alliance for Entrepreneurship. He is also actively involved with educational programs in collaboration with the Rice section of the Society of Automotive Engineers.

Dr. María Vila Santos *(Speaker)*
IMDEA Materials Institute

María Vila Santos has a BSc in Physics from Universidad Complutense de Madrid (UCM), and a PhD from the same university, obtained in 2014. She was a postdoctoral research associate in the European Synchrotron (ESRF), at the Spanish beamline, SpLine, after which she joined, the Madrid Institute for Advanced Studies in Materials (IMDEA Materiales Institute) as a research associate in the Multifunctional Nanocomposites Group (MNG) led by Juan José Vilatela. Her current scientific interest lies in the synthesis of Carbon Nanotube Fibres (CNTF), grown on a CVD synthesis reactor. In particular, her research is focused on the study of the electronic structure of CNTF and the introduction of dopants in the constituent CNTs to modify optoelectronic properties.

Dr Simon G King *(Speaker)*
Advanced Technology Institute
University of Surrey

Dr Simon G King currently works as a Research Fellow at the Advanced Technology Institute (ATI) as part of the Nano-Electronics Centre (NEC). He is also an active member of the Institute of Physics.

Dr King is an alumnus of the University of Surrey (BSc Physics - 2010), and continued at Surrey to complete his doctorate (2014 - "Novel Electrospinning Techniques with Nano-materials").

After a brief period working is the financial sector, Dr King returned to Surrey as a Research Fellow within the University of Surrey's Electrical and Electronic Engineering department, in Prof Ravi Silva's Nano-Electronics Centre. Dr King specialises electrospinning (included nanofibre production and analysis), and nano-materials (including carbon nanotubes and graphene). His current primary research project is titled 'Manufacturing Lightweight Carbon Nanotube Electrical Cables', funding by the EPSRC.

Mark Bowers, *(Speaker)*
ARUP

Mark Bowers is a senior engineer in the materials consulting department of the London office and global materials skills manager for the company having previously led the materials business in the Americas. Mark has an expert knowledge of brittle materials and their failures (glass, stone + ceramic) but also looks at innovative technologies and how they can be applied in the built environment. Over the last 5 years Mark has been leading Arup's Nano Carbon Initiative, developing potential applications with academia and industry as well as looking at the potential challenges in the industry. Along with the nano carbon technologies, Mark has been keenly investigating a novel radiative cooling technology and how it can be applied in new applications.

Dr Elena Polyakova (*Speaker*)
Senior Research Fellow, NUS
CEO, Graphene 3D Lab

Dr. Elena Polyakova is currently Senior Research Fellow at the National University of Singapore. She also serves as Co-Chief Executive Officer at Graphene 3D Lab. Previously Dr. Polyakova had served for two and a half years as the company's Chief Operating Officer. She was instrumental in bringing the first graphene filament to market. Dr. Polyakova is also the co-founder of Graphene Laboratories, Inc. where she has served as the Chief Executive Officer and President since 2009. The company pioneered the commercial graphene production market. Dr. Polyakova has grown the company's client base substantially in the past six years. Her expertise in 2D materials has been covered by prestigious news publishers such as BBC and Bloomberg. Dr. Polyakova has co-authored papers with Nobel and Kavli prize winners, as well as members of the National Academy of Sciences. She previously was one of the first graphene researchers in the Flynn Group at Columbia University. She received a Ph.D. in Physical Chemistry from the University of Southern California and a Master's degree in Physical Chemistry from Moscow Institute of Physics and Technology.

Dr. Elias Koumoulos *(Speaker)*
Innovation in Research and Engineering Solutions
IRES

Dr. Elias P. Koumoulos is the Founder, Managing Director and Principal Consultant of IRES company. Chemical Engineer by his Bachelor studies with MSc on Materials Science and PhD in Nanotechnology, Dr. Koumoulos holds the necessary background to support industrial needs, upscale of primising technologies (lab to fab) and succesful TRL transition. Till now, he has the authorship of over 70 published papers in ISI journals, 6 book chapters, 90 participations in national/international conferences.

Harry Kleijnen, *(Speaker)*
Key Account Manager
Additive Industries b.v.

Since 2006 **Harry Kleijnen** is involved in metal additive manufacturing process development and setting-up a large volume series production facility of 3D printed parts at Philips healthcare. In 2015 he joined Additive Industries where he, in his actual responsibility as Key Account Manager, is working on joined turn key projects with Additive Industries' customers. He studied Electronic Engineering completed with education in business administration.

Dr Yarjan Abdul Samad *(Speaker)*
Cambridge Graphene Centre,
University of Cambridge,

Dr Yarjan Abdul Samad is a Research Associate in the Cambridge Graphene Centre and the Engineering Department of Cambridge University. He is in the Nanomaterials and Spectroscopy Group in the Electrical Engineering Division.

Joe Stallard *(Speaker)*
University of Cambridge,

Joe Stallard is a PhD student in the Department of Engineering at Cambridge University, studying the mechanical and electrical properties of macroscopic carbon nanotube materials. His current research is conducted within the Advanced Nanotube Application and Manufacturing (ANAM) Initiative, a collaboration between industry and academia aimed at converting the promise of macroscopic carbon nanotubes into commercial reality. He has a background in structural analysis, materials and design, undertaking two internships in the computer aided engineering team at Aston Martin Lagonda Ltd., and through leading the structural design of Durham University's Solar Car as an undergraduate. He currently supervises the 1st year materials course at Cambridge, and has supervised and assessed the 2nd year integrated design project. He has served the governing body of Queens' College as President of the Middle Combination Room.

Christine Boyle MBE *(Speaker)*
Senergy Innovations

Christine Boyle Bssc (Hons) Queens University Belfast. CEO, responsible for driving innovation strategy. Brought together a team of global leading engineers from both Queens University and Ulster University alongside experienced polymer manufacturing companies based in Northern Ireland who currently export polymer products to 70 countries worldwide. Raised over 600K whilst retaining 100% equity and sole ownership of the company.

Dr Bojan Boskovic *(Speaker and Organiser)*
CEO,
Cambridge Nanomaterials Technology

Dr Bojan Boskovic is the Founder, Managing Director and Principal Consultant of the company. He has more than 20 years of hands-on experience with carbon nanomaterials and composites from industry and academia in the UK and Europe. Previously, he worked as a R&D Manager at Nanocyl, one of leading carbon nanotube manufacturing companies in Europe. He also worked on carbon nanotube synthesis and applications as a Principal Engineer-Carbon Scientist at Meggitt Aircraft Braking Systems, as a Research Associate at the University of Cambridge, and as a Senior Specialist at Morgan Advanced Materials. During his PhD studies at the University of Surrey he invented low temperature synthesis method for production of carbon nanomaterials that has been used as a foundation patent for the start-up company Surrey Nanosystems. He was a member of the Steering and Review Group for the Mini-IGT in Nanotechnology that advised the UK Government on the first nanotechnology strategy policy document. Dr Boskovic was working as an advisor for the European Commission (EC) on Engineering and Upscaling Clustering and on setting up of the European Pilot Production Network (EPPN) and European Materials Charaterisation Cluster (EMCC). He has experience in exploitation and dissemination management on a number of FP7 and H2020 European projects, including UltraWire, NanoLeap, OYSTER, M3DLoC, Genesis and nTRACK. Also in UK Government InnovateUK funded projects, such as UltraMAT and GRAPHOSITE He is also a leader of two private membership based consortiums: Nano-Carbon Enhanced Materials (NCEM) and Advanced Materials for Additive Manufacturing (AMAM).

UltraWire 2019 Workshop - Organiser

Cambridge Nanomaterials Technology Ltd (CNT)

Web: www.cnt-ltd.co.uk

CAMBRIDGE NANOMATERIALS TECHNOLOGY LTD

The **Cambridge Nanomaterials Technology Ltd (CNT Ltd**) is an innovation management and nanotechnology consulting company based in Cambridge. The CNT Ltd helps companies, academic and government institutions to develop world-class innovative solutions for nanomaterials related R&D and IPR strategy, partnership, products, technologies, funding and markets. CNT Ltd is specialised in carbon nanomaterials R&D consulting and collaborative R&D project management, including exploitation and dissemination management, consortium and supply chain building. CNT has done a

number of patent landscaping and market research analysis studies regarding production and use of various nanomaterials helping to link inventors and technology developers with end-users and investors. The CNT Ltd is a leader of two private membership-based consortiums: Nano-Carbon Enhanced Materials (NCEM) and the new Advanced Materials for Additive Manufacturing (AMAM) with members coming from leading multinational companies and research institutions.

UltraWire 2019 Workshop - Participating Organisations

AIRBUS Defence and Space

AIRBUS Group

Web: www.airbus-group.com

Airbus Group is a European industrial flagship which unites the capabilities of three market leaders: Airbus, Airbus Defence and Space and Airbus Helicopters. EADS has been rebranded as Airbus Group from January 2014. Airbus Military, Astrium and Cassidian are in formation to merge as Airbus Defence and Space. This broad range of products turns the new Division into a top-10 world player in defence and space. **Astrium** is Europe's No. 1 space company and is ranked third worldwide. Part of the international EADS Group and now Airbus Group, they are the only European space company that covers the entire space business, from civil and defence systems to services and applications. Their design, manufacturing and test facilities are among the most advanced in the world. They have unrivalled expertise in the techniques and key technologies required for developing and delivering major space systems. The 18,000-plus employees of Astrium are all driven by the same ambition: to make space technology work for everybody. Their skills, energy and entrepreneurial spirit have contributed to the success of many of the most important projects in space, including Ariane, the International Space Station, ATV, Herschel, Spot & Pléiades constellation, Mars Express and Skynet 5.

Prysmian Group

Web: http://www.prysmiangroup.com

Prysmian Group is world leader in the energy and telecom cables and systems industry. With nearly 140 years of experience, sales of over €7.5 billion in 2016, 21,000 employees across 50 countries and 82 plants, the Group is strongly positioned in high-tech markets and offers the widest possible range of products, services, technologies and know-how. It operates in the businesses of underground and submarine cables and systems for power transmission and distribution, of special cables for applications in many different industries and of medium and low voltage cables for the construction and infrastructure sectors. For the telecommunications industry, the Group manufactures cables and accessories for voice, video and data transmission, offering a comprehensive range of optical fibres, optical and copper cables and connectivity systems. Prysmian is a public company, listed on the Italian Stock Exchange in the FTSE MIB index.

ArcelorMittal

Web: corporate.arcelormittal.com/

ArcelorMittal is the world's leading steel and mining company. Guided by a philosophy to produce safe, sustainable steel, it is the leading supplier of quality steel products in all major markets including automotive, construction, household appliances and packaging. ArcelorMittal is present in 60 countries and has an industrial footprint in 19 countries.

Centro Tecnológico LEITAT

Web: www.leitat.org/english

Leitat is a private technical institute with more than 110 years of experience in industrial innovation processes. We transform technological and scientific results into economic and competitive value for our clients and collaborating entities. Over 1500 customers benefit from our talent, creativity and strong commitment. We bring knowledge and innovation to our customers through applied research and technical testing in the fields of chemistry, energy, environment, materials, engineering and life sciences. We rely upon our 240 highly skilled team members who deliver flexible solutions to face any industrial challenge.

Mitsubishi Heavy Industries Europe, Ltd.

Web: www.mhie.com

MHI Group is a corporate group consisting of some 300 domestic and overseas companies. MHI's business activities encompass everything from design, manufacturing, and construction to sales, after-sales service and general services. Synergies are created among group companies as each strives to develop its own strong and unique business.

Haydale Composite Solutions Ltd

Web: www.haydale.com

HAYDALE Composite Solutions is an independent research and development company based in Loughborough, UK specialising in the development of advanced composites and nanomaterial enhanced composites and their applications. The company employs highly qualified engineers with mechanical engineering and material science backgrounds. The company has extensive knowledge of both thermosetting and thermoplastic based composites, manufacturing processes, structural design and applications across a broad range of industries. The company utilise the latest in computer aided design systems and have access to its own prototyping workshops. We are a global technology solutions company passionate about creating the next generation of advanced materials. We bring together cutting-edge technology with engineering know-how to enhance the performance of products and materials thus delivering business value for our customers.

TWI

Web: www.twi-global.com

TWI is one of the world's foremost independent research and technology organisations, with expertise in materials joining and engineering processes as applied in industry. TWI specialises in innovation, knowledge transfer and in solving problems across all aspects of manufacturing, fabrication and whole-life integrity management. Established in Cambridge, UK in 1946, the organisation has gained a first-class reputation for service through its teams of respected consultants, scientists, engineers and support staff. With around 800 employees, it works with over 1800 Industrial Member companies in over 70 countries. TWI currently operates from 54,000 square metres (581,000 square feet) of manufacturing, testing and training space; five UK and 13 overseas facilities serve both its Industrial Membership and its training and examination needs. A successful international Training and Examinations programme sees around 25,000 students trained each year in welding and inspection technologies.

The University of Strasbourg

Web: www.en.unistra.fr

The **University of Strasbourg** is now a unique, comprehensive university covering all the fields of higher education. It is also the largest French university: 41058 students (including 20.5% foreign students), 11423 trainees in lifelong education, 4635 permanent staff (including 2477 teaching staff, 1872 technical and administrative staff), associated with 1386 researchers, engineers, technicians and administrative staff of the research organizations (CNRS, Inserm and INRA). Courses are taught in 37 faculties, schools and institutes, and research performed in 86 laboratories and research centers. The University of Strasbourg is strongly research-oriented and nearly 400 doctoral theses are submitted annually. It is also a university in the heart of the city of Strasbourg, located on 4 major sites and several other locations in the region of Alsace, counting more than 110 buildings (600 000 mÂ²) and 80 hectares of land. The University of Strasbourg has also a strong commitment to build an Upper Rhine academic community with the Universities of Basel, Freiburg, Karlsruhe and Mulhouse.

R-NANO - National Technical University of Athens

Web: nanolab.chemeng.ntua.gr/?lang=en

The "**Research Unit of Advanced, Composite, Nano Materials & Nanotechnology", R-NanoLab** is situated at the School of Chemical Engineering (Department of Materials Science and Engineering) of National Technical University of Athens (NTUA). It is established since 2006; its research group has extensive experience in Designing, Production and Characterization of Advanced-, Composite- and Nano- Materials.

IMDEA Materials

Web: www.materials.imdea.org/groups/mng

IMDEA Materials (Madrid Institute for Advanced Studies of Materials) is a non-profit independent research institute promoted by the Madrid regional government (Comunidad de Madrid) to perform research in Materials Science and Engineering. IMDEA Materials Institute belongs to the Madrid Institute for Advanced Studies network, a new institutional framework created to foster social and economic growth in the region of Madrid by promoting research of excellence and technology transfer to industry in a number of strategic areas (water, food, energy, materials, nanoscience, networks and software). IMDEA Materials Institute is committed to three main goals: excellence in Materials Science and Engineering research, technology transfer to industry to increase competitiveness and maintain technological leadership, and attraction of talented researchers from all over the world to Madrid to work in an international and interdisciplinary environment.

The Nanoscience Centre

Cambridge University nanofabrication and characterisation facility
Web: www.nanoscience.cam.ac.uk

The **Nanoscience Centre** is an 1800m^2 research facility completed in January 2003 and located at the north east corner of the University's West Cambridge Site. The Centre provides open access to over 300 researchers from a variety of University Departments to the nanofabrication and characterisation facilities housed in a combination of Clean Rooms and low noise laboratories. Office space is primarily home to the Department of Engineering's Nanoscience Group, technical and administrative staff and members of other research groups who require long term access to facilities.

CAMETICS Cambridge Advanced Metals Ltd.

Web: www.cametics.com

CAMETICS Cambridge Advanced Metals Ltd. is an innovative company focused on utilization of unique properties of nanostructured graphitic materials and metals or metal alloys, providing specialised engineering services including design and fabrication of metal/alloy/composite products and welding techniques for aerospace, automotive, nuclear and offshore applications and also developing innovative and unique solution for bonding carbon-based components to other carbon or metal components mainly, but not exclusively, for electrical and thermal applications.

ARUP

Web: www.arup.com

ARUP is a multi-disciplinary engineering firm, offering a variety of services across the built environment from planning to environmental consultancy and traditional SMEP engineering to specialist materials

consulting. Operating with over 15,000 staff in 95 offices across 36 countries. We have had input to many landmark projects over the years including historically the Sydney Opera House or more recently Heathrow Terminal 5 to name but two.

Graphene 3D Lab

Web: www.graphene3dlab.com/s/home.asp

Graphene 3D Lab, Inc. is capitalizing on groundbreaking properties of graphene and other advanced materials. The company is offering high-tech solutions in several areas including:

Blockchain and Cryptocurrency Mining: The Company is developing innovative hardware for harvesting the heat generated by the cryptocurrency mining computational hardware and converting it into heating and/or refrigeration solutions.

R&D Materials: These diverse materials have a wide spectrum of commercial, research, and military applications. The Company's wholly-owned subsidiary, Graphene Laboratories Inc., currently offers over 100 graphene and related products to a client list comprised of more than 14,000 customers worldwide, including nearly every Fortune 500 tech company and major research university. Some notable clients are NASA, Ford Motor Co., GE, Apple, Xerox, Samsung, Harvard University, IBM, and Stanford University. The Company's suite of products is available online at the company's e-commerce platform Graphene Supermarket (www.graphene-supermarket.com).

3D Printing: The 3D printing division of the Company offers a portfolio of 3D printable filaments. These materials can be purchased through multiple distribution networks worldwide or directly from the web-store www.blackmagic3D.com.

High-Performance Epoxies: Adhesive materials produced by the company are distributed under the G6-Epoxy trade name.

National University of Singapore

Web: http://nus.edu.sg
http://www.nus.edu.sg/global/

Founded in 1905 as a modest medical school with 23 students, NUS is today widely known for our innovative and rigorous education which has nurtured generations of leaders and luminaries across industries, professions and sectors in Singapore and beyond. Our singular focus on talent will be the cornerstone of a truly great university that is dedicated to quality education, influential research and visionary enterprise, in service of country and society.

Imperial College London

Web: www.imperial.ac.uk

Imperial College London is a science-based university with an international reputation for excellence in teaching and research. Consistently rated amongst the world's best universities, Imperial is committed to developing the next generation of researchers, scientists and academics through

collaboration across disciplines. Located in the heart of London, Imperial is a multidisciplinary space for education, research, translation and commercialisation, harnessing science and innovation to tackle global challenges.

Additive Industries

Web: additiveindustries.com

Additive Industries is accelerating industrial additive manufacturing of high quality, functional, metal parts by offering a modular, end-to-end laser powder bed fusion system, MetalFAB1 system, and seamlessly integrated information platform, Additive World Platform, to high end and demanding industrial markets. With substantially improved reproducibility, productivity, and flexibility, Additive Industries redefines the business case for series production of additive manufacturing applications in aerospace, automotive, medical technology and high-tech equipment. Established in 2012 in the "Brainport Ecostructure" around Eindhoven in The Netherlands, Additive Industries is the world's first dedicated equipment manufacturer for industrial metal additive manufacturing systems

Brunel Innovation Centre (BIC) - Brunel University London

Web: www.brunel.ac.uk/research/Institutes/Institute-of-Materials-and-Manufacturing/Structural-Integrity/Brunel-Innovation-Centre

Brunel Innovation Centre (BIC) is part of the Institute of Materials and Manufacturing of Brunel University. BIC was founded in 2009 in collaboration between Brunel University London and TWI, and is based in Granta Park, Cambridge. The research carried out at BIC is predominantly in the field of NDT, CM, SHM, Power Ultrasonic and related areas, including:

- SHM / CM (Acoustic emission & ultrasonic guided waves)
- Ultrasonic Cleaning / De-icing / Material Processing
- Smart NDT (automation, wireless, IMUs)
- Sensors and transducers (aggressive environments; high temperature)
- Signal / Image Processing/Machine learning
- Systems (hardware-software) integration

IRES

Web: innovation-res.eu

IRES, is an R&D consulting company, is dedicated to new and innovative nanotechnology solutions. Headquartered in Brussels (Belgium), IRES is a team of key collaborators that provide supporting services such as IP, market research, environmental solutions and marketing advice. Currently, IRES is a member of 10 EU funded research projects consortia, in the field of advanced materials, piloting, research ethics and nanosafety. Our mission is to deliver to our customers world-class innovative solutions for development of materials-based products. Our experience in combination with the use of strong analysis tools, provides us the chance to provide our consumers with high-quality consulting services. More specifically, inhouse risk & safety tools on demand successfully identify possible

business risks and provide respective sustainable solutions depending on our customers' needs. Overall, we ensure sustainability through the whole lifecycle of products through the holistic evaluation of social, environmental and economic aspects based on EU standards and regulations.

Cambridge Graphene Centre - University of Cambridge

Web: www.graphene.cam.ac.uk

The mission of the **Cambridge Graphene Centre** is to investigate the science and technology of graphene, carbon allotropes, layered crystals and hybrid nanomaterials. This engineering innovation centre allows our partners to meet, and effectively establish joint industrial-academic activities to promote innovative and adventurous research with an emphasis on applications. The facilities and equipment have been selected to promote alignment with industry, by filling two main vacuums. The first is the lack of intermediate scale printing and processing systems where the industrial upscale and optimization of inks based on graphene, related carbon nanomaterials, and novel two dimensional crystals can be tested and optimized. The second vacuum stems from the challenge posed by the unique properties of graphene: the centre facilities aim to fully cover those properties necessary to achieve the goal of "graphene-augmented" smart integrated devices on flexible/transparent substrates, with the necessary energy storage capability to work autonomously and wireless connected. Gate the science and technology of graphene, carbon allotropes, layered crystals and hybrid nanomaterials. This engineering innovation centre allows our partners to meet, and effectively establish joint industrial-academic activities to promote innovative and adventurous research with an emphasis on applications.

University of Cambridge - Department of Engineering

Web: www.eng.cam.ac.uk

The Department of Engineering is the largest department at the **University of Cambridge** and one of the leading centres of engineering in the world. Renowned for both its teaching and research, the Department's aim is to address the world's most pressing challenges with science and technology. To achieve this aim, the Department collaborates with other disciplines, institutions, companies and entrepreneurs. The Department's strength lies in its integrated approach to research and teaching; the unique way in which it applies its capability across all aspects of engineering and gathers partners to find solutions. To build even stronger integration, speed and agility, the Department's philanthropic development campaign will create a new home for Engineering at West Cambridge. The new campus will set the course for 21st century engineering around the world by seamlessly interweaving research, teaching and partnership with industry. The campaign will also open opportunities for the next generation of engineers with new academic posts, studentships and schools' outreach.

SENERGY

Web: www.senergyinnovations.co.uk

With a background spanning almost 20 years in the commercial roofing industry, **Senergy** are a Belfast based enterprise that design and manufacture SMART Solar Thermal Panels. By combining our roofing expertise with that of global leading engineers, we have developed the Senergy solar thermal panels. Unlike current solar thermal panels that are made from glass, copper and aluminium, Senergy panels are manufactured using advanced nanocomposite plastics. Being aware of the sun's potential to deliver limitless amounts of solar energy, Senergy was inspired to design an architecturally attractive solution that would reduce the upfront cost of a solar heating system making it affordable to harness the sun's renewable energy.

E.G.O. Elektro-Gerätebau GmbH

Web: www.egoproducts.com/en/home

E.G.O. is an international high-tech company and one of the leading global manufacturers of domestic appliance technology, components and products. Other industries, ranging from medical technology through building services to automotive technology, benefit from our pioneering spirit, our experience and our expertise. Ever since the company was founded in 1931, we have been inventing sophisticated technology that makes people's day-to-day lives easier. Carrying on this tradition is what drives us on each and every day.

EURECAT

Web: eurecat.org/en

Eurecat is the main Research and Technology (RTO) centre in Catalonia and the second largest private non-profit research organization in Southern Europe. **Eurecat** provides the industrial and business sector with differential technology, advanced expertise and solutions to their innovation needs. The range of services offered by the centre are primarily focused on applied R+D+i, technological services, information technology consulting, highly-specialized training, product and service development, and promotion and distribution of technological innovation. The centre brings together the experience of more than 670 professionals, generating an annual income of €51M. Serving more than a thousand companies, Eurecat is involved in 160 national and international R&D projects with high strategic value. The RTO holds 36 international patents and 8 technology spin-offs. We offer world-leading laboratory and test facilities in a wide range of technological fields. Our more than 20 exclusive advanced laboratories include the largest plastic processing plant in Southern Europe. Additive Manufacturing (AM) is a strategic research line at Eurecat's New Manufacturing Processes unit constituted by a team of 12 researchers and technicians, supported with other teams of experts in materials, simulation and product development, adding up to more than 50 researchers. The aim is to generate know-how and technology in Additive Manufacturing, by developing new 3D printing processes.know-how and technology in Additive Manufacturing, by developing new 3D printing processes.

SHWire

Web: www.sh-wire.de/en

Since its foundation **SHWire** has developed into an acknowledged quality leader within its industry. The product range encompasses all enamelled copper and aluminium wires demanded by the winding wire industry on a global basis. In addition to the standard types required, SHWire develops and produces new types of enamelled wires, including the innovative low friction SHTherm® 210 GLIDE and the „shaped“wire, which provides superior mechanical properties way above current industry standards.

Trackwise Designs PLC

Web: www.trackwise.co.uk

TRACKWISE
CONNECTING TECHNOLOGY

Trackwise manufactures to customer specification, specialist products using printed circuit technology. Working across two primary divisions, Radio Frequency (RF) and Improved Harness Technology™ (IHT), our specialist circuits are used globally in RF/antenna and lightweight interconnect products, across multiple market sectors and applications.

TEKNAN Conductors

Web: teknan.com

TEKNAN

Teknan Conductors is introducing Carbon Nanotubes in industrial processes aiming to improve the electrical conductivity and capacity for derivated applications such as electric motors and wire cables. Having its own CNT's generation method, the company is seeking to reduce costs and improve the quality of the whole chain, from the generation process to the final application.

University of Surrey - Advanced Technology Institute

Web: www.surrey.ac.uk
www.surrey.ac.uk/ati/about

UNIVERSITY OF SURREY

The Advanced Technology Institute is an interdisciplinary research centre dedicated to advancing next-generation electronic and photonic device technologies. Our strategy is based on having selective and focussed programmes of research, each of critical mass, which embrace in their investigations the full spectrum of fundamental science through to applied engineering. From our contributions to the design of the first strain layer laser in the mid 80's to rapid thermal annealing and production of SIMOX for semiconductors in the 90's to nano-materials and nano-technologies in the last decade; our researchers have been at the forefront in helping to solve some of the most challenging problems in industry today. We are also examining such issues as the fabrication of cheap renewable energy sources, and work with industry to deliver high quality output wherever it is required. Presently, there are some 160 researchers working in the ATI.

Brunel Composite Centre

Web: www.twi-innovation-network.com/innovation-centres/brunel-composites-innovation-centre

Brunel Composite Centre is part of the Institute of Materials and Manufacturing of Brunel University

- Principal mission is to establish a world class research centre offering high quality research
- Various ongoing research on the phenomena that take place at the interface of composites to other materials and physicochemical processes studies including processing of composites, embedding of smart structures in composites and joining of composites with other materials.

Coatema® Coating Machinery GmbH

Web: www.coatema.de/en

Coatema Coating Machinery GmbH offers a full range of equipment and R&D for coating, printing and laminating plants for Roll-to-Roll and Sheet-to-Sheet applications. Our second-generation family owned business has over 40 years of experience in the textile, foil and paper markets and offers lab, pilot and production lines for these sectors. Coatema has been the market leader for 15 years in the pilot line sector with innovative technologies for batteries, fuel cells and printed electronics. A focus on high tech markets, world class service support and one of the most versatile R&D center in the world for coating, printing and laminating enables Coatema to offer complete laboratory to fabrication (Lab-to-Fab) technologies. In addition to the established sectors of vertically integrated machine engineering, Coatema is continuously active in German and European research projects and organizes an international coating symposium every year in Dormagen. As a global acting SME Coatema has a worldwide distribution network and serves all growth markets with their products.

Chord Electronics Ltd.

Web: chordelectronics.co.uk/products

Born out of the uncompromising world of avionics, at Chord Electronics we focus on two main objectives: creating the world's finest sounding hi-fi and pushing the boundaries of innovation. We engineer visually unique and sonically stunning designs that defy time.

Bridon-Bekaert - The Ropes Group

Web: www.bridon-bekaert.com

We hold over 300 years of specialized experience in steel wire and synthetic ropes and cords solutions, serving thousands of customers globally. What makes us unique and valuable to you? It's a variety of elements, including: The engagement and expertise of our people: our people are at the core of our business, and it is their knowledge, experience and commitment that provide the foundation of our

competitive advantage in comparison with our competitors. Our technology leadership: the combination of rope technology strength and wire technology strength will provide a platform for strong differentiation in the high-end rope markets. Our ability to serve different markets: oil & gas, elevator, surface and underground mining, cranes and industrial, infrastructure, fishing, forestry. Our global footprint: with 17 manufacturing locations around the world, we hold strong positions in the US and Europe, Latin America, Canada and Australia, and have huge growth opportunities across Asia. Although we were founded recently, in June 2016, our heritage spans several centuries. It is this heritage, combined with a strong vision, purposeful goals and high impact leadership which makes us the world leader in our field.

Aurubis

Web: www.aurubis.com

Aurubis is the leading integrated copper group and the world's largest copper recycler. We produce some 1 million t of copper cathodes each year and from them a variety of copper products. Aurubis has about 6,300 employees, production sites in Europe and the USA and an extensive service and sales system for copper products in Europe, Asia and North America. Thanks to our wide range of services, we rank among the global leaders in our industry. Our core business is the production of marketable copper cathodes from copper concentrates, copper scrap and recycling raw materials. These are processed within the Group into continuous cast wire rod, shapes, rolled products and strips as well as specialty wire made of copper and copper alloys. Precious metals and a number of other products, such as sulfuric acid and iron silicate, round off our product portfolio. Customers of Aurubis include companies in the copper semis industry, the electrical engineering, electronics and chemical industries as well as suppliers of the renewable energies, construction and automotive sectors. Aurubis is oriented to growth and to increasing corporate value. The main focus of our strategy is on strengthening our business, utilizing growth opportunities and practicing a responsible attitude when dealing with people and handling resources and the environment. Aurubis shares are part of the Prime Standard Segment of the Deutsche Börse and are listed in the MDAX, the European Stoxx 600 and the Global Challenges Index (GCX).

MBDA

Web: http://www.mbda-systems.com/

MBDA is the only European group capable of designing and producing missiles and missile systems to meet the whole range of current and future needs of the three-armed forces. A multi-national group with 10,000 employees working together across France, Germany, Italy, Spain and the United Kingdom. Offices also set up in USA. Jointly held by 3 prestigious shareholders: AIRBUS (37.5%), BAE Systems (37.5%) and Leonardo (25%).

Energy Safety Research Institute (ESRI)

Web: www.esri-swansea.org/en

The Energy Safety Research Institute building at Swansea University's Bay Campus forms part of the College of Engineering. The Energy Safety Research Institute concentrates the College of Engineering's strength in the energy sector. The Energy Safety Research Institute is supported by industry sponsors. It focuses on the safety issues surrounding the development and expansion of existing energy processes, as well as the safe deployment and integration of new 'green' energy technologies. The design and construction of a new 3,800m2 building enables the University to develop the quality and scale of its research efforts in the areas of energy and safety. The vision of the Energy Research Safety Institute (ESRI) and Swansea University is "building the bridge to a sustainable, affordable and secure energy future."

Rice University

Department of Materials Science & Metallurgy

Web: rice.edu

Rice is a private, independent university dedicated to the "advancement of letters, science, and art." Rice attracts a diverse group of highly talented students with a range of academic studies that includes humanities, social sciences, natural sciences, engineering, architecture, music, and business management. The school offers students the advantage of forging close relationships with members of the faculty and the option of tailoring graduate and undergraduate studies to their specific interests. The Electrical and Computer Engineering Department provides high quality undergraduate and graduate degree programs, which emphasize fundamental principles that respond to and create technological change.

Argonne National Laboratory

Web: www.anl.gov

Argonne National Laboratory, one of the U.S. Department of Energy's national laboratories for science and engineering research, employs 3,400 employees, including 1,400 scientists and engineers, three-quarters of whom hold doctoral degrees. Argonne's annual operating budget of around $760 million supports upwards of 200 research projects. Since 1990, Argonne has worked with more than 600 companies and numerous federal agencies and other organizations. Argonne's mission is to apply a unique mix of world-class science, engineering and user facilities to deliver innovative research and technologies. They create new knowledge that addresses the most important scientific and societal needs of our nation. They also actively seek opportunities to work with industry to transfer our technologies to the marketplace through licensing, joint research and many other collaborative relationships.

UCL

Web: http://www.ucl.ac.uk/

UCL was founded in 1826 to open up higher education in England to those who had been excluded from it – becoming the first university in England to admit women students on equal terms with men in 1878. The Faculty of Mathematical and Physical Sciences encompasses the logical, experimental and mathematical study of our Universe. The Faculty is an internationally renowned centre for both theoretical and applied research and a centre of educational excellence. Front-line research feeds directly into our teaching programmes, and our students benefit from access to first-class laboratory facilities.

RTE - Réseau de Transport d'Électricité

Web: www.rte-france.com

RTE is the French electricity transmission system operator. It is a public service company responsible for operating, maintaining and developing the high and extra high voltage network. It guarantees the reliability and proper operation of the power network. RTE transports power between electricity suppliers (French and European) and consumers, whether they are electricity distributors (ERDF and the local distribution companies) or industrial consumers directly connected to the transmission system. With 100,000 km of lines between 63,000 and 400,000 volts and 45 cross-border lines, the network operated by RTE is the biggest in Europe. In 2008, RTE posted turnover of €4,221M and currently employs around 8,500 staff.

Annexes

Photos of the event

Contact information

If you are interested in joining the **UltraWire** community and get more information, please contact us at:

info@ultrawire.eu

www.ultrawire.eu

or

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info@CNT-Ltd.co.uk

www.CNT-Ltd.co.uk