ULTRAWIRE 2017 WORKSHOP

Workshop on Commercialisation of Ultra-conductive Composites

Post-Event Report v2.0

12th & 13th July 2017

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

Dinner Venue: *Senior Combination Room*
St Catharine's College
Cambridge, CB2 1RL, UK

Organised by:

CAMBRIDGE NANOMATERIALS TECHNOLOGY LTD

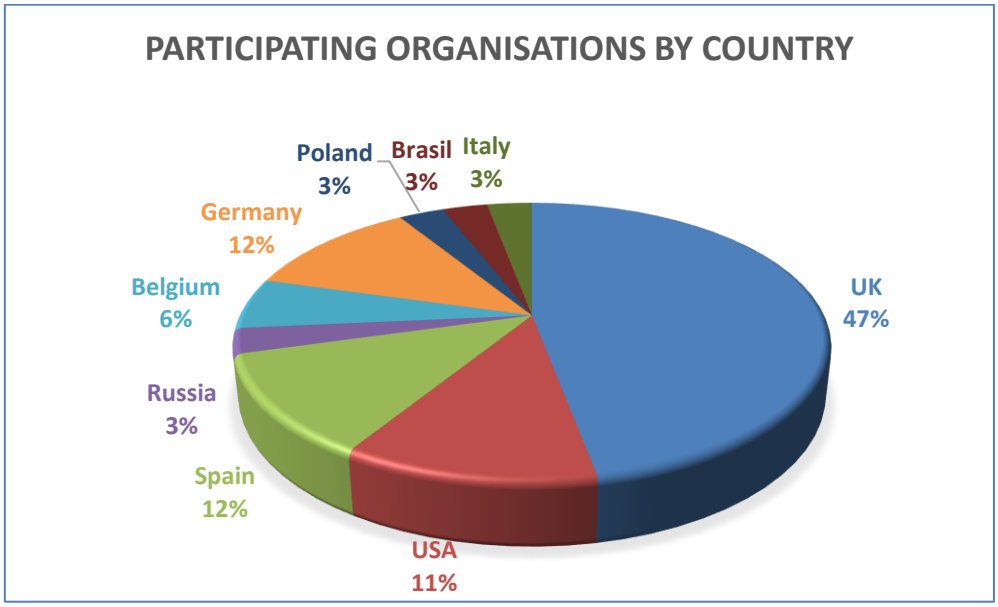
Contents

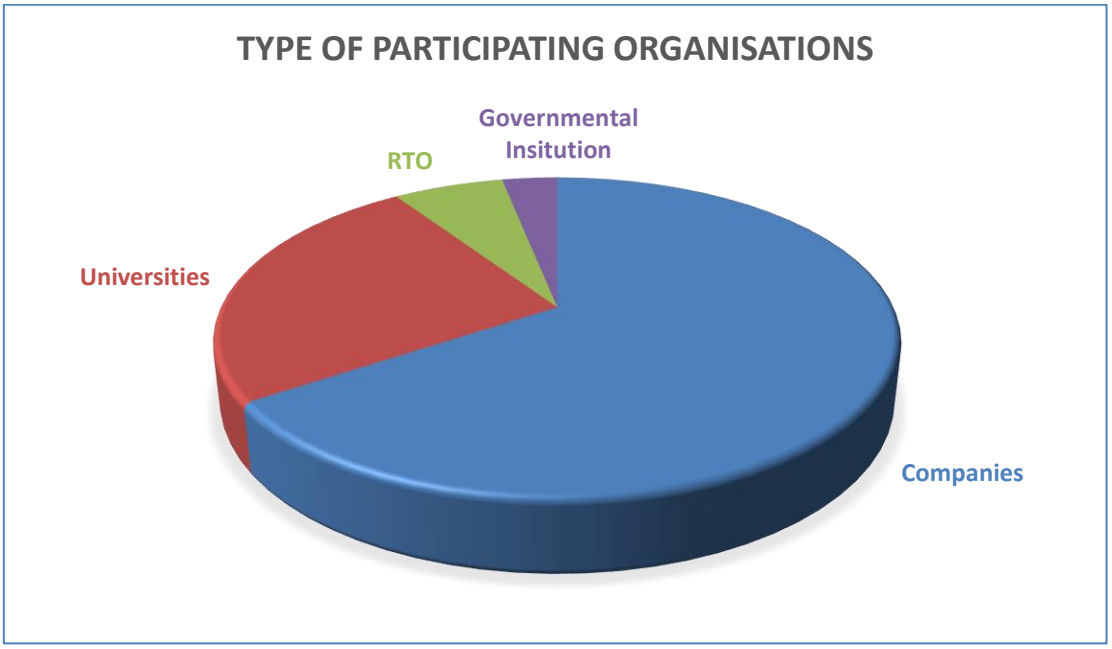
Summary

Cambridge Nanomaterials Technology Ltd (CNT) organised the **UltraWire Workshop 2017** at Wolfson College in Cambridge on 12 & 13 July 2017, in order to support commercialisation of nano-carbon wire technology and development of nano-carbon materials and metal composites for a number of applications such as electrical energy transmission and transport, by bringing together technology development leaders and industrial end-users. At the **UltraWire 2017 Workshop** participants had the opportunity to meet the UltraWire project researches and learn about their progress in development of nano-carbon wire technology. This was a platform to exchange experience for all technology developers in industry and researchers in academia, working on nano-carbon and metal composite materials.

The UltraWire (Ultra Conductive Copper-Carbon Nanotube Wire) project was funded by European Commission 7th Framework Programme (EC FP7). The project started on the 1st October 2013 and finished on the 30th September 2016; it had the participation of 14 partners. The aim of the project was to develop a copper nanocarbon composite with significantly improved overall properties, including electrical, thermal and mechanical performances over bulk copper. CNT was responsible for the management of exploitation and dissemination activities of the UltraWire Project. We organised the UltraWire workshops in September 2015 in Cambridge, UK and in September 2016 in Leuven, Belgium, to help exploitation and dissemination of results of

At the UltraWire 2017 Workshop, over 40 people participated in both days. Participants came from different countries not only from Europe, but North and South America.





Feedback from participants

"I would like to thank you once more for your hospitality and for offering the opportunity to join the NCEM/Ultrawire workshops and interact with fascinating scientists/entrepreneurs."

Professor and Senior Researcher
University of Minho

"thanks a lot … very good organization of the meeting!"

Professor
Technische Universität Chemnitz

"Thank you very much for your efforts and organization of this great event."

Manager, Research Promotion & Society Research
Nissan Research Center-Russia

List of participating organisations

Organisation	Country
AIRBUS	UK
ArcelorMittal	Spain
Argonne National Laboratory	USA
Aurubis	Belgium
Bose	UK
Cambridge Nanomaterials Technlogy Ltd	UK
Carbodeon	UK
CIC nanoGUNE	Spain
CTNano - Centro de Tecnologia em Nanomateriais	Brasil
GrapheneTech S.L.	Spain
InnovateUK	UK
International Copper Alliance	USA
MBDA	UK
Mitsubishi Heavy Industries Europe, Ltd.	UK
MKM Mansfelder Kupfer und Messing GmbH	Germany
Nissan Research Center-Russia	Russia
Prysmian Group	Italy
Rice University/Swansea University	USA
Robert Bosch GmbH	Germany
Rolls Royce	UK
SH Wire - Schwering & Hasse Elektrodraht GmbH	Germany
Swansea University	UK
Talga Technologies Limited	UK
Technische Universität Chemnitz	Germany
Technische Universität Bergakademie Freiberg	Germany
Tecnalia	Spain
Toyota Motor Europe NV SA	Belgium
UltraConductive Copper Company. UC3	USA
University College London	UK
University of Cambridge	UK
University of Cranfield	UK
University of Huddersfield	UK
University of Surrey	UK
Versarien	UK
Warsaw University of Technology	Poland


UltraWire
AIRBUS DEFENCE & SPACE
Rolls-Royce
BOSE
ArcelorMittal
MITSUBISHI HEAVY INDUSTRIES EUROPE, LTD.
Prysmian Group
LINKING THE FUTURE
TOYOTA
BOSCH
Invented for life
NISSAN MOTOR CORPORATION
NISSAN
DATSUN
SHWIRE
Magnet Wires
ALWAYS A BETTER WAY
MBDA
MISSILE SYSTEMS
Cu
Copper Alliance™
Argonne
NATIONAL LABORATORY
talga
unearthing tomorrow
Innovate UK
UNIVERSITY OF CAMBRIDGE
tecnalia
Inspiring Business
Aurubis
mkm
wir leben kupfer
Versarien
PLC
GrapheneTech
CTNANO
Warsaw University
Carbodeon
RICE
Cranfield University
UCL
TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG
CIC nanoGUNE
TECHNISCHE UNIVERSITÄT CHEMNITZ
UNIVERSITY OF SURREY
UC3
UltraConductive Copper Company
ESRI
Swansea University
Prifysgol Abertawe
University of HUDDERSFIELD
Cambridge Nanomaterials Technology Ltd

Agenda UltraWire 2017 Workshop

Day 1

Date: 12th July 2017

Venue: Gatbsy Room
Wolfson College Cambridge

14:00 **Dr Bojan Boskovic**, UltraWire Exploitation and Dissemination Manager, CEO, Cambridge Nanomaterials Technology Ltd

- **Welcome and Introduction to the UltraWire Workshop 2017**
- **Overview to the EC FP7 UltraWire project (www.ultrawire.eu) and post project end activities**

14:15 **Dr Balu Balachandran,** Argonne National Laboratory, USA

Title: Nanocarbon-infused Metals: A New Class of Covetic Materials for Energy Applications*

Covetic materials are metals that have been infused with nanocarbon using a unique electro-charging process. The process can produce structures that seem thermodynamically unavailable via conventional processing methods but remain stable once established. The nanocarbon particles are tenaciously bound to the metal, increasing the metal's strength, electrical conductivity, and thermal conductivity. Covetic nanomaterials could become commercially important because the process is scalable to tonnage quantities and has widespread implications for energy savings in thousands of potential applications from high-voltage electrical wires to solar cells and batteries. We measured ~15% increase in thermal conductivity and ~30% increase in electrical conductivity in covetic copper compared with the base copper from which the covetic was produced. In the case of covetic grey iron, we measured ~50% increase in thermal conductivity compared to its parent grey iron. We utilized Scanning Transmission Electron Microscopy (STEM) and Helium Ion Microscopy (HIM) for the investigation of the carbon nanostructures in copper covetics. STEM elemental mapping revealed carbon-rich regions and networks. HIM provides contrast and resolution for observing nanophase carbon structures in covetic metal hosts. Covetic materials will be a game-changer for materials scientists and engineers who have long sought to combine light-weight and high-conductivity carbon with metal in their pursuit to improve materials performance. Examples of improvements in the properties of covetic copper and iron will be presented in this talk along with results from STEM, HIM, and thermal analysis of the materials.

This work was supported by the U.S. Department of Energy (DOE), Energy Efficiency and Renewable Energy, Advanced Manufacturing Office, under Contract DE-AC02-06CH11357. Part of the work was performed at the Center for Nanoscale Materials at Argonne National Laboratory, a DOE Office of Science User Facility. Helium Ion Microscopy was conducted at the Center for Nanophase Materials Sciences at Oak Ridge National Laboratory, which is a DOE Office of Science User Facility.

15:00 *Coffee break*

15:30 **Prof. Dr. Andrew R. Barron**, Charles W. Duncan, Jr. - Welch Chair of Chemistry and Professor of Materials Science, Rice University, USA

16:00 **Dr Alvin Orbaek White,** Senior Lecturer and Sêr Cymru II Fellow, Energy Safety Research Institute (ESRI), Swansea University, UK

Title: Ultralong single walled carbon nanotubes and electrical transmission

Being able to manufacture carbon nanotubes in lengths hundreds of metres long would enable their use for electric cabling. Currently 8% of the total amount of electricity is lost during transmission via copper cabling. In addition, copper cabling is unsustainable environmentally and economically, thus its replacement is an urgent global need. Carbon nanotubes transmit electricity more effectively due to ballistic conduction, with near-zero loss and can be used at any temperature making them suitable for use in any part of the world. Until recently carbon nanotubes have only been manufactured in small lengths in a form unsuitable for wiring. The work of Zhang et al in producing a 50 cm length of carbon nanotube has demonstrated that longer lengths are feasible. Our recent work has shown that ultralong length scales can be readily achieved by precisely controlling laminar flow conditions, in this way SWCNT lengths of 30 mm were grown. But creating an electrical wire calls for longer SWCNTs, and for novel techniques so that the ultralong SWCNTs be made into wires in-situ. In short, aligned carbon nanotubes with aspect ratios of 20,000-30,000 are required to make cables with mechanical and electrical properties that surpass copper cables which I will discuss in this presentation.

16:30 **Dr. Siva Böhm -** Chief Technology Officer at Talga Technologies Ltd, UK & Talga Advanced Materials GmbH, Germany.

Title: Tuning graphene for applications with enhanced conductivity

With its impermeable and conductive nature graphene can replace nano-additives currently used in various applications [1-3]. The current bottlenecks in graphene commercialisation is the availability of large volume, cost-effective high quality graphene and its effective incorporation. Talga has the capability and resources to bring graphene into the market in big volume with its cost effective industrially scalable process and overcome the compatibility issues with tuning its surface chemistry to incorporate into existing products. When overcoming these factors, coatings & composites may prove to be the most significant demand drivers for graphene in terms of volume consumption and speed to market.
In this talk, utilisation of Talga electrochemically expanded graphite and few layer graphene in various advanced conductive products and their performance will be discussed. Recent progress of development carried out by Talga in independent laboratories and examples of commercial product development will be discussed.

17:00 *End of the Day 1 session*

19:00 *Dinner at St Catherine's College Cambridge*


UltraWire Workshop 2017

Workshop on Commercialisation of Nano-Carbon Wire Technology

Day 2

Date: 13th July 2017

Venue; Roger Needham Room (meeting) –
Gatsby Room (exhibition and coffee breaks)
Wolfson College Cambridge

09:00 *Arrival and registration*

09:15 Welcome & Introduction

Dr Bojan Boskovic, CEO, Cambridge Nanomaterials Technology Ltd, UK

09:30 **Prof Krzysztof Koziol,** EC FP7 UltraWire Project Coordinator**,** Professor of Composites Engineering, Head of Enhanced Composites and Structures Centre, University of Cranfield, UK

Title: UltraWire Project Overview and future activities

10:00 **Denise Willems,** RD&I, Aurubis Belgium, Belgium

Title: UltraWire: The Cu-based conductor of the future

In many electrical systems, copper is the preferred material of use owing to its excellent thermal and electrical conductivity. However, more and more applications call for the use of materials with properties exceeding those of copper. In recent years, nano-carbon materials have attracted more and more attention due to their exceptional electrical, mechanical and thermal properties. The combination of copper with nano-carbon materials could be a way to produce the Cu-based conductor of the future. A conductor that is stronger, has a higher conductivity and higher current carrying capacity than copper. For the manufacturing of copper carbon composites, three routes are explored: casting, electrolytic plating and powder metallurgy.
Can these composites be made efficiently, and if so, how? What problems can be expected? Which properties can be expected and are achieved in reality? The latest results of the Ultrawire project will be presented.

10:30 **Dr Vlad Stolojan,** Advanced Technology Institute, University of Surrey UK.

Title: Manufacturing Lightweight CNT Cables by electrospinning

Description: Electrospinning is a technique which draws, using a high electric field, very thin fibres from a visco-elastic polymer solution. When the solution is combined with dispersed carbon nanotubes, the polymer fibres can draw out and align individual carbon nanotubes, resulting in polymer-CNT composite mats where both the polymer fibres and the CNTs inside them are aligned in a specific direction. The polymer can then be thermally removed such that we can obtain aligned CNT fibres and papers. This method is applicable to all CNT sources, including CNTs that have undergone several purification steps. Our ultimate goal is to use the electrospun CNT products and improve their conductivity by managing defects to lead to CNT 'welding', based on welding studies performed under electron beam irradiation. Here we present some of our conductivity results and show that SWNT behave as thermistors, whilst

MWCNT behave as classical resistors, and discuss steps that can lead to improved conductivity.

11:00 *Coffee break and networking*

11:30 **Prof. Henning Zeidler,** Head of the Chair Additive Manufacturing, Technische Universität Bergakademie Freiberg, Germany

Title: Anisotropic Carbon/Aluminium based material composites for efficient heat transport

The heat evacuation problem is omnipresent. For many technologies in which heat generation limits the performance of systems it may be a serious obstacle hampering their advancements. Finding effective and efficient solutions to address this problem still remains a demanding challenge. However, recent developments in science and technology offer some promising innovations to make a change. Newly developed heat conductive materials such as Graphene or Pyrolytic Graphite are carbon-based materials. They are perfect thermal dissipation agents. Their conductivity values are of up to ten times that of aluminium and five times that of copper, which are the current industry standards. However, their mechanical properties hinder their stand-alone applications. Inserts made of Graphene or Pyrolytic Graphite can be inserted into an aluminium envelope of high strength and low weight to function there as “thermal highways”. This allows creating smart aluminium metal matrix composite - or AMC -, a heat conductive material of unique thermal properties.

The talk presents latest findings and approaches of the novel concept of carbon-based “thermal highways”, which was developed and implemented within the THERMACO project - a joint effort of an international consortium of 11 partners from research and industry, collaborating under the flag of the Factories of the Future topic of the EU 7th Framework Programme for Research and Innovation.

12:00 **Dr Agnieszka Lekawa-Raus,** Research Fellow in the Department of Mechatronics, Warsaw University of Technology, Poland

Title: Is it worth working on pure carbon nanotube wires?

It has been proposed quite a while ago that macroscopic conductors made purely of carbon nanotubes could transform the area of electrical engineering by replacing copper/aluminium wiring in such applications as electrical machines (transformers, generators, motors), high voltage power lines or high frequency cables. The gain of using carbon nanotube conductors has been intuitively sought among low weight, high conductivity, increased mechanical strength or decreased skin effect. Unfortunately, our first trials of producing e.g. electrical transformer or motor were not fully successful as carbon nanotube wires produced up to now have been characterized by insufficient electrical conductivity which resulted in poor performance of the whole machine. The poor electrical performance of carbon nanotube assemblies led to many projects targeting at doping of nanotube conductors or combining of carbon nanotubes with metals. Seeing very promising results of such research the point of working on pure carbon nanotube wires may be questioned. Our recent study tried to target this issue with some theoretical considerations. It has been found that indeed carbon nanotube wires could easily outperform classical conductors. However, their structure needs to the carefully designed with regard to specific application.

12:30 **Dr. Raquel Gonzalez,** GrapheneTech, Spain

Title: Graphene Production and New Product Development

Graphene is one of the most revolutionary materials of the 21st century. Its unique properties such as breaking strength one hundred times higher than steel, specific electrical and thermal

conductivity higher than copper and specific surface area of 2,630 m2/g make possible its application in a wide variety of sectors. Graphene industry will be about 133.77 million € by 2020, and up to 440 million € by 2024. However, to reach these estimations it is necessary to face the challenges existing today for the commercialization of graphene: to produce high quality material on a large scale at low cost, and in a reproducible manner.

During this talk I will focus on the synthesis and the application of graphene for the polymer sector, mentioning the level of progress achieved in GrapheneTech. Regarding the characteristics of the graphene material, the addition of single-layer graphene powder to polymeric matrixes at large scale is still far due to its extremely low density that results in important technical difficulties concerning its dosage in extrusion/injection systems and especially, its elevated economical costs. For these reasons, nowadays, graphene nanoplatelets (as our GPx products) represent the most suitable and promising solution. Then, the incorporation of graphene into polymer matrix is challenged by some parameters as the dispersion. In order to enhance the properties of the composite is strongly required to have a homogeneous material uniformly dispersed. Our R&D department (in collaboration with other companies) develops tailored made dispersions by both in situ polymerization or addition of the GPx products to preexisting polymers:

- We have produced polyurethane (PU)/graphene foams with different cell sizes and graphene loads that exhibit enhanced heat dissipation and thermal properties. This type of nanocomposite will be incorporated in high-tech mattress.
- We have carried out the dispersion of our graphene into thermoplastic polymers, such as high density polyethylene (HDPE), polystyrene (PS) and polypropylene (PP), improving their mechanical properties with low proportions of graphene. These achievements allow the partial substitution of the pristine polymers.
- We are working in collaboration with 3R3D Technology Materials S.L to develop a conductive graphene filament specifically designed for 3D printing of electrically conductive components.
- We have developed a highly conductive ink based on graphene that could be easily applied with a pencil in many different surfaces.

13:00 *Lunch, Networking and Exhibition*


14:00 **Dr. Falko Boettger-Hiller,** Professorship Surface Engineering / Functional Materials**,** Technische Universität Chemnitz, Germany

Title: Metallized carbon fibers for functional CFRP

Efficient lightweight construction requires intelligent materials that fulfill a wide range of functions. The inca-fiber approach is to metalize carbon fibers to produce functional carbon fiber reinforced plastics (CFRP).
To date, zinc, tin, and copper and nickel have been deposited on carbon fibers by electroplating. The metallised fibers can be embedded in a polymer matrix and further processed into CFRP components. The metallic functional layer can be used as for joining the CFRP elements. In addition, the metallised layers are examined for further advantageous properties, such as improved barrier properties against fluids, improved adhesion properties, improved wear protection.

14:30 **Dr. Kalyan Sarma,** Horizon 2020 National Contact Point for Nanotechnology and Advanced Materials, Innovate UK

Title: UK Investment & Capabilities in Nanotechnology & Advance Materials & Innovation Hubs.

15:00 **Discussion**

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

- **UltraWire Technology Development Trends**
- **UltraWire Technology Development Barriers**
- **UltraWire Technology Development Collaboration**
- **European Pilot Production Network (EPPN)**
- **Innovation Hubs**

15:30 *Coffee break and networking*

17:00 *End of the Day 2 session*

UltraWire 2017 Workshop – Speakers

Prof. Dr. Andrew R Barron *(Speaker)*
Professor of Materials Science
Rice University,

Professor Dr. Andrew Barron is the Charles W. Duncan, Jr. - Welch Chair of Chemistry and Professor of Materials Science 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. Since 2002, the focus of research within the Barron Research Group has involved the functionalization of fullerenes and single walled carbon nanotubes (SWNTs). Areas being investigated include: biological applications and interactions, catalysis and materials applications. Functionalization of fullerenes as amino acids allows for their inclusion into polypeptides for the development of new approaches to the treatment of flagrant diseases. The development of a catalytic approach for the amplification of SWNTs may be likened to the polymerase chain reaction for DNA and is aimed at the fabrication of specific nanotube structures for energy applications. 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.

Mr Alvin Orbaek White, *(Speaker)*
Senior Lecturer and Sêr Cymru II Fellow
Energy Safety Research Institute (ESRI)
Swansea University

Dr. Alvin Orbaek White is a Senior Lecturer and Sêr Cymru II Fellow and at the Energy Safety Research Institute (ESRI). His vision is to advance global energy sustainability through the development of more efficient and equitable methods of transporting electricity. Throughout his academic career, Dr. Orbaek White has worked to develop innovative methods to synthesize and characterize carbon nanomaterials. He completed his PhD on the catalytic growth of single walled carbon nanotubes, he has managed several projects related to the application, separation, characterization, wet-chemistry and synthesis of single walled CNTs, and multi walled CNTs. At the Massachusetts Institute of Technology, he developed a novel technique resulting in an approximate one hundred-fold increase in length of CNTs, called ultra-long CNTs. Education and mentorship is also a priority. For instance, Dr. Orbaek White developed a teaching laboratory module for undergraduate chemistry students on plasmonic silver nanoparticles. He also raised funds through a program called Project SEED providing students from low-income households with a summer stipend and the opportunity to conduct chemistry research at Rice University. Dr. Orbaek White was recently awarded UK Digital Economy Crucible, during which he plans to investigate the changing energy industry landscape due to the use of ultra-conductive electricity cables, better understand network distributions and the mathematical logic underpinning smart grid methodology.

Prof. Krzysztof Koziol, *(Speaker)*
Head of Enhanced Composites and Structures Centre
Cranfield University

Dr Krzysztof Koziol is the Head of the Electric Carbon Nanomaterials Group. His current research is in the area of synthesis and applications of substrate-bound and gas-phase-grown carbon nanotubes, with a particular focus on chirality control of carbon nanotubes. In addition, he is exploring two methods of making carbon nanotube fibres; the first is based on direct and continuous spinning from carbon nanotube aerogel, where up to 70 meters per minute of fibres can be achieved. These fibres show exceptional mechanical properties - a combination of strength, stiffness and toughness - but also very high electrical and thermal conductivity. The second method is based on spinning Carbon Nanotube fibres from liquid dispersion of well-defined structures of carbon nanotubes. During his previous research projects, he developed various methods for the synthesis, purification, chemical modification and fabrication of highly aligned nanotubes and polymer composites. In addition he discovered a new synthesis route which solves the problem of the chirality control challenges of carbon nanotubes. Using this process he has been able to synthesise armchair or zigzag type nanotubes. His other current research interests include: post treatment and applications of pure carbon nanotube and carbon nanotube polymer composites as well as design and testing of various devices based on carbon nanotube wire technology.

Dr Siva Böhm *(Speaker)*
Chief Technology Officer
Talga Technologies Ltd

Dr. Siva Böhm received his first degree in Berlin in Chemical Engineering and an M.Sc. in Applied Chemistry at Hahn Meitner Institute (MPI) in Berlin. After gaining his PhD at the University of Bath in the field of Chemistry/Electrochemistry, Dr. Böhm worked as scientific officer and research fellow at different academic institutions; University of Wales Swansea, TU Delft and the University of Birmingham. During 2014 – early 2016, he was an honorary visiting Professor at India Institute of Technology Bombay working in the field of synthesis of Graphene and its applications in protective coatings, corrosion protection, energy harvesting and storage, construction materials, leightweight composite as well as sensors. Dr. Böhm has 16 years of industrial research experience (Tata Steel & Tata Group) in various research fields; metallurgy, corrosion inhibition, protective coatings in construction, electrical steel and automotive industry, functional and smart coatings and various aspects of nanotechnology, including synthesis and applications of Graphene. He is responsible for developing and implementing a number of new products at commercial scale, holds 26 patents and has written over 85 scientific publications. Since 2016, Dr. Böhm works as Chief Technology Officer at Talga Technologies Ltd, Cambridge UK & Talga Advanced Materials GmbH, Germany, where he is focussing Swedish Ore to very Few layer Graphene and developing value-added products using industrial high volume Graphene, Graphite and Graphite Ore. Dr. Siva Böhm is a Member of Royal Society of Chemistry with a charted chemist status and Fellow of Technical of Surface Coatings & Oil and Colour Chemist Association. In addition, he is reviewer for several peer-reviewed journals and a member of the editorial board at Flatchem. Recently, Siva has been awarded the Royal Society Industrial Fellowship.

Denise Willems (Speaker)
RD&I
Aurubis Belgium

Denise Willems is a materials engineer graduate from KU Leuven working since 2016 at Aurubis Belgium as research, development and innovation manager. Her research activities have focused on improving existing production processes and developing new copper products.

Dr U. (Balu) Balachandran, Ph.D. *(Speaker)*
Argonne Distinguished Fellow
Argonne National Laboratory

Dr. U. (Balu) Balachandran received his Ph.D. in Materials Science in 1980. He has been doing research in the area of electronic materials for over 35 years. His research areas include nano-carbon infused metals for high thermal and electrical conductivity, high temperature capacitors for power electronics in electric drive vehicles, fuel cells, high–temperature superconductors, ceramic membranes for gas separation, chemical synthesis, and natural gas upgrading. He has been an invited speaker at 114 conferences in several countries. He is a Fellow of The American Ceramic Society (1999) and Fellow of the Institute of Physics (2006). He has authored/coauthored 272 papers in peer reviewed international journals, 166 papers in conference proceedings, edited 22 books (conference

proceedings/transactions), and holds 42 issued patents. He has organized several symposia and technical sessions for the American Ceramic Society, Materials Research Society, TMS (The Minerals, Metals & Materials Society), International Cryogenic Materials Conference (ICMC), and Applied Superconductivity Conferences (ASC). Balu has been on the Editorial Boards of Superconductor Science & Technology (2001-2009), Journal of Materials Transactions, The Japan Institute of Metals (2000 – present), and Journal of Materials Physics and Mechanics (2001 – present). Balu has won four R&D 100 Awards, two Federal Laboratory Consortium (FLC) Awards for Excellence in Technology Transfer, two FLC Awards of Merit, three Laboratory Director's Awards, Distinguished Alumni Award, and University of Chicago's Distinguished Performance Award (the highest honor offered at Argonne National Laboratory for scientific achievement).

Prof. Dr.-Ing. Henning Zeidler *(Speaker)*
Chair of Additive Manufacturing
Institute for Machine Elements, Engineering Design and Manufacturing (IMKF)

Henning Zeidler was born in 1979; he studied Microtechnics and Mechatronics at Technische Universität Chemnitz in Germany, where he also obtained his PhD in mechanical engineering in 2012. From 2012 to 2017 he was chief executive engineer of the professorship Micromanufacturing Technology at Technische Universität Chemnitz. Since 2013 he is chairman of the board of Beckmann-Institute for Technology Development and co-founder of the AMtopus GmbH&Co.KG in Chemnitz, Germany. Since 2017 he holds the chair in Additive Manufacturing at Technische Universität Bergakademie Freiberg. His research foci are Additive Manufacturing processes including e.g. new/multi materials, binder jet printing and direct metal deposition as well as surface functionalisation, for example using Plasma electrolytic Polishing. Additionally, he has been working on micro- and precision machining using EDM, ECM and hybrid processes such as ultrasonically assisted micro EDM for many years. Amongst other projects, he was scientific manager of the EU FP7 THERMACO project on integration of carbon-based materials into cast aluminium parts for extremely efficient heat transfer.

Dr. rer. nat. Falko Böttger-Hiller *(Speaker)*
Technische Universität Chemnitz

2008 TU Chemnitz diploma thesis: „Tungsten containing twin-monomers for nanoscale, electrochromic coatings" 2012 TU Chemnitz PhD thesis „Template assisted twin polymerisation for an high-performance energy storage" - 2012-2014 Head of junior researcher group – functional CFRP - 2014-2017 Scientific staff of Cluster of excellence „MERGE" - Technologies for Multifunctional Lightweight Structures - 2017 CEO of inca-fiber GmbH

Dr Agnieszka Lekawa-Raus *(Speaker)*
Research Fellow
Warsaw University of Technology

Agnieszka Lekawa-Raus is a Research Fellow at Warsaw University of Technology, Poland. As a holder of a 3-year grant for young Leaders of Polish Science funded by National Centre for Research

and Development, she is currently running her first research group whose main focus is on the development of nanocarbon based electrical conductors, machines and electronics. She has been gaining her research experience while working and studying for PhD degree in Materials Science at University of Cambridge UK, pursuing an Electrical Engineering degree at Lublin University of Technology, Poland as well as visiting Kanazawa University, Japan and Los Alamos National Laboratories, USA. Her main interest is in the novel conductive materials, nanocarbons, electrical machines and functional composites.

Dr Vlad Stolojan *(Speaker)*
Advanced Technology Institute
University of Surrey

Dr Vlad Stolojan is a Senior Lecturer in Nanomaterials Characterisation, working in the Advanced Technology Institute as part of the Nano-Electronics Centre. He is a member of the Institute of Physics and a fellow of the Royal Microscopical Society. Dr Stolojan is an alumnus of University of East Anglia (BSc Physics -1996) and of the University of Cambridge (PhD Physics -2001 Nanochemistry of grain boundaries in iron"). He first joined the University of Surrey's School of Engineering in 2001 as an expert in electron microscopy and energy-loss spectroscopy, continuing as an RCUK Fellow with the University of Surrey's Electrical and Electronic Engineering department, in Prof Ravi Silva's group. Dr Stolojan is an author of over 100 peer-reviewed publications and a reviewer for a number of journals (Carbon, Applied Surface Science, Ultramicroscopy, etc.).

Dr Kalyan Sarma *(Speaker)*
Horizon 2020
National Contact Point for Nanotechnology and Advanced Materials
Innovate UK

Dr Kalyan Sarma is the H2020 National Contact Point for Nanotechnology and Advanced Materials (N&M) at Innovate UK. His role is to advice UK organisations engaged in Horizon 2020 calls on participation rules and proposal procedures. Kalyan is also a Department for Business, Innovation and skills (BIS) nominated expert at the NMBP programme committee at the DG RTD, Brussels. Kalyan has many years of experience in technology transfer, and worked in projects ranging from UK regional development agencies to technical and market analysis for business and academic groups in Micro and Nano Technology. He also worked for a Singapore based technology incubator, which aims to develop a high technology investment portfolio in the UK and Singapore. His principal role was to develop the company as a technology incubator and evaluate a number of projects from technical and business planning perspectives. Kalyan has a B.Eng in Electrical and Electronics Engineering from the University of Madras, and a PhD in Biotechnology from the University of Cambridge.

Dr Raquel González *(Speaker)*
GrapheneTech,

Raquel González Teresa has a Master's degree in Nanoscience and Advanced Materials at Donostia International Physics Centre-Basque Country University and a PhD in Physics of Nanostructures and Advanced Materials. Dr Raquel González started her PhD in TECNALIA within the framework of a

European FP7 project, CODICE, focused on the prediction of the structural evolution and the mechanical performance of nondegraded and degraded cementitious matrix by means of advanced computational simulations. After her PhD she started a postdoc in the R&D department at T.E. Laboratories (Ireland). Dr Raquel Gonzalez was working on delivering revolutionary advances in liquid sample handling combined with new approaches to performing sensitive in-situ analytical measurements through the application of innovative breakthroughs in nanomaterials and microfluidics. Moreover, she did a postdoc at the Department of Civil and Environmental Engineering at Vanderbilt University. She was involved in different projects supported by the American Nuclear Society (ANS) the National Science Foundation (NSF). At the present, she is the Head of the R&D department of GrapheneTech. She is on charge of the development of new products, based on the addition of graphene nanoplatelets, which are competitive in the market through extensive product and market research.

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

Dr Bojan Boskovic is a NCEM Programme Director at the CfBI and a founder and a CEO of the Cambridge Nanomaterials Technology Ltd (www.CNT-Ltd.co.uk) a consultancy company specialised in carbon nanomaterials. He has more than ten 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 The Morgan Crucible PLC. During his PhD studies at the University of Surrey he invented a low temperature carbon nanofibre synthesis method using PECVD. This research was granted a patent, published in Nature Materials and utilised by CNT synthesis equipment manufacturer Surrey Nano Systems. He and his team at the Cambridge Nanomaterials Technology Ltd helped a number of companies to understand the patents and market landscape and develop R&D strategy regarding carbon nanomaterials. He is also working as an advisor for the European Commission (EC) on Engineering and Upscaling Clustering regarding setup of the European Pilot Production Network (EPPN) and European Materials Characterisation Cluster (EMCC). He has experience in management of Exploitation, Dissemination and Business Planning related activities in European collaborative R&D FP7 and Horizon 2020 projects (ElectroGraph, UltraWire and NanoLeap).

UltraWire 2017 Workshop - Organiser

Cambridge Nanomaterials Technology Ltd (CNT)

Web: www.cnt-ltd.co.uk

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 2017 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.

BOSE Corporation

Web: www.bose.com/en_us/index.html

Bose Corporation is an American privately held corporation, based in Framingham, Massachusetts, that specializes in audio equipment. Founded in 1964 by Dr.Amar G. Bose, the company sells its products throughout the world. The primary vision of their founders wasn't about making quick money. It was about inventing new technologies that would truly benefit people, and creating a culture where innovation and teamwork are valued above all else. Better sound is just the beginning. They are passionate engineers, developers, researchers, retailers, marketers … and dreamers. Their main goal is to create products and experiences their customers simply can't get anywhere else.

Rolls-Royce

Rolls-Royce : Strategic Research

Web: www.rolls-royce.com/about/our-technology/research/research-programmes.aspx

Rolls-Royce is a global company providing highly-efficient integrated power and propulsion solutions. Our power systems are predominantly used in aerospace, marine, energy and off-highway applications. We are one of the world's leading producers of aero engines for large civil aircraft and corporate jets. We are the second largest provider of defence aero engines in the world. Rolls-Royce is well established in the marine sector where we design vessels and integrate power systems. We have a growing presence in civil nuclear power, drawing on our skills and experience of over 50 years in powering nuclear submarines. Our MTU brand is world-renowned in high-speed diesel engines powering applications as diverse as rail locomotives and luxury yachts. **Rolls-Royce Research & Technology (R&T)** is responsible for developing technologies from their earliest concept stage to the point at which they are available for demonstration in an operational environment. R&T Programmes are broadly classified in terms of their Technology Readiness Level (TRL).

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.

Nissan

Web: www.nissan-global.com
www.nissan-global.com/EN/NRC/

Nissan Motor Company Ltd, usually shortened to Nissan, is a Japanese multinational automobile manufacturer headquartered in Nishi-ku, Yokohama. The company sells its cars under the Nissan, Infiniti, and Datsun brands with in-house performance tuning products labelled Nismo. Nissan is a global full-line vehicle manufacturer that sells more than 60 models under the Nissan, Infiniti and Datsun brands. In fiscal year 2015, the company sold more than 5.4 million vehicles globally, generating revenue of 12.2 trillion yen. Nissan engineers, manufactures and markets the world's best-selling all-electric vehicle in history, the Nissan LEAF. Nissan's global headquarters in Yokohama, Japan manages operations in six regions: ASEAN & Oceania; Africa, Middle East & India; China; Europe; Latin America and North America. Nissan has been partnered with French manufacturer Renault since 1999 and Mitsubishi Motors since 2016 under the Renault-Nissan Alliance.

International Copper Association (ICA)

Web: www.copperalliance.org

Cu Copper Alliance™

The International Copper Association is the industry association for the world-wide copper production industry. They are a New York not-for-profit corporation with 37 member companies, 15 offices worldwide and with a retained staff of 220 people. 28 of our members are global copper production companies; together they are responsible for more than 50% of refined copper production worldwide. The remaining members are some of the world's largest global copper fabrication companies. Our mission is to grow and defend markets for copper, based on its superior technical performance and its contribution to a higher quality of life.

Tecnalia

Web: www.tecnalia.com/en/

tecnalia Inspiring Business

FUNDACION TECNALIA RESEARCH & INNOVATION (TECNALIA) is a private, non-profit and independent research organisation resulting from the merger of eight research organisations: Fundación Cidemco, Fundación European Software Institute, Fundación European Virtual Engineering, Fundación Fatronik, Fundación Inasmet, Fundación Labein, Fundación Leia and Fundación Robotiker. TECNALIA is the leading private and independent research and technology entity in Spain and the fifth largest in Europe. TECNALIA employs 1,437 people (164 PhDs) and its turnover is 121Me, it filed 53 patents, had 3800 clients and created 8 spin-offs in 2009. TECNALIA is very active in the Seventh Framework Programme (FP7) having already gained 150 projects, and coordinating 31 of them. Innovation Systems, Sustainable Development (Energy, Construction and Environment), Industry and Transport (Casting and iron & steel, Transport and Industrial Systems), ICT (Software, Telecom, Infotech and Information Society) and Health and Life Quality (Health and Life Quality) are the fields in which TECNALIA operates.

Innovate UK

Web: www.gov.uk/government/organisations/innovate-uk

Innovate UK

Innovate UK is the new name for the Technology Strategy Board. We are the UK's innovation agency, accelerating economic growth. We know that taking a new idea to market is a challenge. We fund, support and connect innovative businesses through a unique mix of people and programmes to accelerate sustainable economic growth. We work with people, companies and partner organisations to find and drive the science and technology innovations that will grow the UK economy. We're an organisation of around 250 staff, drawn mainly from business and with a head office in Swindon.

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).

Swansea University - 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

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. Argonne is managed by UChicago Argonne, LLC, for the U.S. Department of Energy's Office of Science. They are located on 1,500 acres (6.9 sq. km) in southwest DuPage County, Illinois 25 miles (40 km) southwest of Chicago. The site is completely encircled by the beautiful Waterfall Glen Forest Preserve.

Technische Universität Chemnitz

Web: www.tu-chemnitz.de/

Chemnitz University of Technology is located in the town of Chemnitz in Germany. With over 10000 students it is the third largest university in Saxony and around 750 international students from 100 universities all over the world are enrolled each year. It was founded in 1836 as Royal Mercantile College ("Königliche Gewerbeschule") and became a technical university in 1986. Situated in the centre of the 'Wissenschaftsregion' ('science region') Chemnitz, Technische Universität (TU) Chemnitz hosts about 11,000 students from 75 countries. With approximately 2,000 employees in science, engineering and management, TU Chemnitz counts among the most important employers in the region. Today, TU Chemnitz stands for distinctively-profiled and outstanding research. Within the key research areas 'Energy-efficient Production Processes', 'Smart Systems and Materials' and 'Human Factors in Technology' solutions for the challenges of tomorrow are developed.The main issues regarding

economic and social developments are influenced by mega trends such as globalization, demographic change and the availability of resources. The profile of TU Chemnitz is characterized by the interaction of the key research areas mentioned above and has generated a unique constellation of competencies across eight faculties. Thanks to this constellation, Chemnitz develops into an internationally visible research hub for future value creation processes.

Cranfield University

Web: /www.cranfield.ac.uk/manufacturing

Cranfield University has a distinctive approach to manufacturing research. We combine expertise in design, technology and management along with research into materials sciences together, all with a focus on manufacturing. We teach more than 300 postgraduate students in areas ranging from manufacturing technology to systems and management. Research students work in fields as diverse as ultra-precision engineering to the novel application of Virtual Reality technologies to support maintenance and through-life engineering services. We work in Technology Readiness Levels (TRL) 1-6. Cranfield offers a part-time executive manufacturing Master's programme to develop industry professionals who can lead business change and innovation. From 2016 we will also run a Manufacturing Leadership Programme for SMEs and a Manufacturing Directors Programme. We work with more than 1500 businesses and governments around the world. Through our industry connections guest lecturers, often senior managers in leading companies, provide insight into current industry challenges. Many industry contacts actively recruit our graduates.

Schwerubg & Hasse Elektrodraht GmbH

Schwering & Hasse is a reliable partner of the international electro-technical industry. Sophisticated quality management and stable production processes are guarantors for a successful cooperation. The long-term business relationships with the leaders in the various market segments underline this fact.

Warsaw University of Technology

Web: ' www.pw.edu.pl/engpw

Warsaw University of Technology builds upon the traditions of Polish technical universities that used to function in Warsaw. the Polytechnic Institute founded in 1826 thanks to the efforts of Stanisław Staszic and the School of Hipolit Wawelberg and Stanisław Rotwand established in 1895. Warsaw University of Technology started on its own in 1915 thanks to the efforts of the Association for Scientific Courses and the Citizens' Committee of the City of Warsaw. Working uninterruptedly, the University has been producing generations of graduates and has had an increasing number of scientific and technical achievements. It is not only the oldest, but also the best technical university in Poland; in the ranking of Polish universities, it has taken the first place in its category for nine years. At Warsaw University of Technology, over 180 student research groups, organisations and associations are active, and the educational offer includes more than 30 fields of study (also with English as a medium of instruction).

MKM

Web: www.mkm.eu/en/contact.html

MKM is a leading European manufacturer of primary and semi-finished products made of copper and copper alloys. As a company with more than a century of expertise we have always offered ground-breaking technologies, service concepts and solutions tailored to the market, and true German quality.

CTNano

Web: ctnanotubos.com.br/

CTNano is a technology center for carbon nanotubes (NTC) and graphene, which focuses on the development of products, processes and services from these classes of materials with a nanometric structure of outstanding strategic importance for the competitiveness of Multiple industries. We have as main motivation the promotion of the competitiveness of the national industry from the technological development of tip. Our vision is to serve as a platform for technology transfer and generation of entrepreneurial societies.

Mitsubishi Heavy Industries Europe, Ltd.

Web: www.mhie.com/en/

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.

Talga Technologies Limited

Web: www.talgaresources.com

Talga Resources Ltd (ASX: TLG) is a technology minerals company enabling stronger, lighter and faster products for the coatings, battery, construction and carbon composites markets using graphene and graphite. Talga has significant advantages owing to its in-house graphene product development team, 100% owned unique high grade mineral deposits in Sweden and a pilot process facility in Germany. New products are being developed using Talga's graphene/graphite materials at Talga Technologies Limited UK to suit customers such as industrial conglomerate Tata, BASF subsidiary Chemetall, UK listed Haydale, Zinergy UK Ltd and German based Jena Batteries amongst others.

Bosch

Web: www.bosch.com/

BOSCH
Invented for life

In 1886, Robert Bosch founded the “Workshop for Precision Mechanics and Electrical Engineering” in Stuttgart. This was the birth of today's globally active **Robert Bosch GmbH.** Bosch, is a German multinational engineering and electronics company with its headquarters in Gerlingen, near Stuttgart, Germany. Bosch's core products are automotive components, industrial products and building products

Prysmian Group

Web: www.prysmiangroup.com/

Prysmian Group LINKING THE FUTURE

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.

University College London

Web: www.ucl.ac.uk/

UCL

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.

Versarien™ plc

Web: www.versarien.com/

Versarien PLC

Founded in 2010, Versarien utilises proprietary technology to create innovative new engineering solutions that are capable of having a game-changing impact on a broad variety of industry sectors.

We have already gained considerable industry recognition and received a number of high profile awards, including the London 2012 UKTI Startup Games Overall Winner, 2013 Racecar Engineering

Magazine's Most Innovative Product Award, 2012 MWP Advanced Manufacturing Award for Research and Development and 2012 HP Smart Business Award for Manufacturing Innovation. Versarien Group graphene related activities are having an impact in a broad variety of industry sectors through our subsidiaries: 2-DTech Ltd, which specialises in the supply, characterisation and early stage development of graphene products. www.2-dtech.com ACC Cyroma Ltd, which specialises in the supply of vacuum-formed and injection-moulded products to the automotive, construction, utilities and retail industry sectors. Using Versarien's existing graphene manufacturing capabilities, AAC will have the ability to produce graphene-enhanced plastic products. www.aaccyroma.co.uk Cambridge Graphene Ltd, which supplies novel inks based on graphene and related materials, using patented processes and develops graphene materials technology for licensing to manufacturers. www.cambridgegraphene.com

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.

University of Huddersfield

Web: www.hud.ac.uk/

The **University of Huddersfield** is a public university located in Huddersfield, West Yorkshire, England. The institution was incorporated as a Higher Education Corporation (HEC) on 21 November 1988. They have world-leading applied research groups in biomedical sciences, engineering and physical sciences, social sciences and arts and humanities. The University of Huddersfield became the Times Higher Education University of the Year in November 2013.

Carbodeon

Web: www.carbodeon.net/index.php/en/

Carbodeon is a Finnish company which manufactures nanodiamond materials. The products consist of powders or liquid dispersions of <10nm diamond particles with functional surface chemistry. The

main applications are in enhancing the properties of wear resistant or low friction polymer coatings & metal plating, and in modifying the thermal and mechanical properties of various polymers, particularly in thermally conductive applications.

Fairland Technology

Web: fairlandtech.com/

Fairland Technology is a company specialising in providing business development and technical support to small companies aiming to develop and commercialise new technologies. Specific areas of experience are in nanomaterials and automotive technologies. Fairland Technology is also the exclusive outlet for Carbodeon's "Nicanite" graphitic carbon nitride material.

Toyota Motor Europe NV/SA

Web: /www.toyota-europe.com/

Toyota Motor Europe NV/SA (TME) oversees the wholesale sales and marketing of Toyota and Lexus vehicles, parts and accessories, and Toyota's European manufacturing and engineering operations. Toyota directly employs around 20,000 people in Europe and has invested over EUR 9 billion since 1990. Toyota's operations in Europe are supported by a network of 30 National Marketing and Sales Companies across 53 countries, a total of around 3,000 sales outlets, and nine manufacturing plants. In 2015, Toyota sold 873,844 Toyota and Lexus vehicles in Europe.

University of Surrey - Advanced Technology Institute

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

The **Advanced Technology Institute** at **University of Surrey** 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.

GrapheneTech

Web: www.graphene-tech.net

GrapheneTech is a dynamic company, with high capacity to manufacture Graphene, working every day to become a world leader in the technology of Graphene by adapting it to the specific needs of each client. We manufacture Graphene in the form of nanoplate, we specialize in producing large scale for different industrial applications using our patented method that allows us to offer prices adapted to industrial needs, that complex and costly methods do not allow. More than six years of experience in the field of high performance nanomaterials, we share the vision of our customers with our scientific staff formed by a multidisciplinary of PhDs in physics and chemistry with experienced R & D international, making us a reference of prestige, able to develop the services that we offer with an accurate communication, constant and direct with our customers and partners and, a total commitment to the projects we develop. We are eco-friendly, competitive and adaptable Our production of Graphene is conducted in our manufacturing process "top-down", graphite exfoliation, at low cost and in a friendly manner with the environment. Consequently, the quality of the obtained Graphene nanoplates is highly marketable

MBDA

Web: 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. MBDA is 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. It is jointly held by 3 prestigious shareholders: AIRBUS (37.5%), BAE Systems (37.5%) and Leonardo (25%).

CIC NanoGUNE

Web: www.nanogune.eu/

NanoGUNE is a research center with the mission of performing world-class nanoscience research for the competitive growth of the Basque Country. NanoGUNE is a non-profit making Association promoted by the Basque Government in 2006. A Governing Board, currently composed by all partners, is the final responsible for the overall management of the center.

Technische Universität Bergakademie Freiberg

Web: tu-freiberg.de/

Being a University of Resources, the **TU Bergakademie** - focuses comprehensively on securing the supply of natural resources along the entire added value chain. It covers the spectrum from the exploration for new deposits, the low impact, environmentally sound extraction of the raw materials as well as the development of alternative energy technologies and efficient materials right up to the recycling process. The basic idea of sustainable development remains at the forefront at all times. The TU Bergakademie Freiberg thus provides society with the basis for an environmentally compatible

supply of resources which are essential for universal economic growth. Researchers in Freiberg use cooperative relationships with industry representatives on the regional and national level as well as with international businesses to carry out fundamental research activities that have practical relevance. For years, the professors of the TU Bergakademie Freiberg have ranked among the absolute elite in Germany in terms of third-party funds.

Annexes

Photos of the event

Contact information

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

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www.ultrawire.eu

or

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