GRAPHOSITE

A GRAPHENE SENSOR FOR DEFECT DETECTION & PREDICTIVE MAINTENANCE IN COMPOSITE MATERIALS

Open Day 2021

Preliminary Agenda
Speakers & Participating Organisations

Date: 16 April 2021

Time*:* 09:30 – 16:00

Location: ZOOM Digital Platform

Innovate UK This project is supported by Innovate UK
GRAPHOSITE Project Ref. 104266

Contents

GRAPHOSITE

A Graphene Sensor for Defect Detection & Predictive Maintenance in Composite Materials

The **GRAPHOSITE** is a project funded by **Innovate UK** (reference 104266) which started in August 2018 and will run until June 2021.

GRAPHOSITE offers a technological solution that addresses a significant challenge to composite materials – defect detection. It aims to apply graphene to a customised substrate to achieve enhanced defect sensing and predictive maintenance with increased sensitivity. The sensor will be embedded with the composite during manufacturing and will have high flexibility properties. A unique feature of the novel technology is that graphene will serve as the sensing element and act as the gate through with the electric current passes. Being an embedded part of the composite at manufacture, condition monitoring will therefore be continuous and in real-time.

www.graphosite.co.uk

The **GRAPHOSITE Open Day** will be a great opportunity to learn about the GRAPHOSITE project results, meet their partners and learn about their products and services. There would be also an opportunity to learn about the project partners, their products and services via specifically design virtual exhibition EXPO website.

GRAPHOSITE Open Day 2021 - Preliminary Agenda

Please note that all times shown in the agenda are British Summer Time (BST).

09:30 Welcome to the GRAPHOSITE Open Day

Bojan Boskovic, Managing Director, Cambridge Nanomaterials Technology Ltd (CNT)
GRAPHOSITE Project Exploitation and Dissemination &
Open Day 2019 Organisation

George Maistros, Managing Director at ADVISE-DETA
GRAPHOSITE Project Coordination and Management

09:35 Introduction to the GRAPHOSITE Open Day Workshop and EXPO

Presentation of the meeting agenda, virtual exhibition EXPO website and individual introduction of the workshop participants

Bojan Boskovic, Managing Director, Cambridge Nanomaterials Technology Ltd (CNT)
GRAPHOSITE Project Exploitation and Dissemination &
Open Day 2019 Organisation

10:30 George Maistros, Managing Director at ADVISE-DETA

Title: Sensors for quality assessment of composite materials

The current activities of ADVISE-DETA are focusing on the application of quality assessment (in-process and in-service) for composite materials. There is a variety of sensors ranging from electrical to interdigital and ultrasound. The company has developed all the components of a complete quality assessment system, DETA SCOPE™, linked to the sensing system and equipped with material science models for the evaluation of quality. The readings from the sensors are translated to actual material properties or state (i.e. viscosity, degree of cure, strain, condition). There are variants of DETA SCOPE in the form of Defect Detection System or Process Performance Monitoring System. The operation of the system helps to improve efficiency of composites production and detection of defects and poor condition of composite structures. The core technology development within ADVISE-DETA lies with sensors in the form of interdigital electrodes. They are sensing elements with custom design circuit in the form of grid of 'fingers'. To facilitate evaluation of material state, the company has developed several modelling tools on the electric field analysis of the sensor structures and on signal interpretation.

11:00 **Natalia Garban & Fokion Oikonomidis,** TWI Ltd, UK,

Title: Graphene sensor for measuring strain: a comparison between traditional methods and a graphene sensor

TWI will present the results obtained from Graphosite project where the graphene sensor was validated by performing tests under different loading conditions that provide information about its mechanical response, sensitivity and its suitability for measuring displacement.

11:30 *Break*

11:45 **Romilly Close**, Haydale Graphene Industries PLC

Title: Bringing Functionalised Nanomaterials to Industry

This presentation will give a brief introduction into Haydale and its patented functionalisation technology that it has developed to improve the interaction of nanomaterials when dispersed in polymer systems. This will be followed by an overview of some of the key applications that Haydale are currently focused on to support the commercialisation of nanomaterials. A number of case studies will be presented to demonstrate some of the significant steps forward that have been made over the past few years, with highlights including R&D activities in diverse markets such as elastomers and composites; where functionalised nanomaterials have been incorporated with a range of benefits.

12:15 **Akram Zitoun**, Research Fellow, Brunel Composites Centre

Title: Graphene-based strain sensing in composites for structural and health monitoring applications

Graphene is well known for its excellent physical properties. The presentation covers the use of graphene-based strain sensors systems for the assessment of the health of composite structures. The graphene sensor was applied on the composite structure through different scenarios. It was attached on CFRP and GFRP coupons either on the surface or embedded. The work focused on composite structure as they are more interest across different industrial sectors due to their mechanical properties.

12:45 **Zlatka Stoeva** Managing Director, DZP Technologies Ltd

Title: Emerging applications of printed graphene sensors: a case study for lithium-ion battery safety

Graphene sensors exhibit unique properties such as ultra-high sensitivity and fast response to different chemical, mechanical and thermal stimuli. This enables their application across different sectors, from monitoring the structural health of composite structures, to detection of corrosion in infrastructure projects, and monitoring wellbeing and health in wearable technology. This presentation will outline a recent development by DZP Technologies which utilises thin-film graphene thermal sensors for predicting safety critical events in lithium-ion batteries for electric vehicle applications.

13:15 *Lunch break*

14:15 **Sofia Billett,** Senior Innovation Consultant, Cambridge Nanomaterials Technology Ltd.

Title: Support with the commercialisation of graphene applications

CNT is supporting commercialisation of nanomaterials applications, specialised in carbon nanomaterials including graphene, through dedicated exploitation and dissemination related activities, in a number of European Commission and UK Government funded projects. Multidisciplinary background of CNT experts provides necessary knowledge for technology monitoring and IPR landscaping advice and training related to many different technologies ranging from biomedical to energy and sustainability. CNT is also providing support related to nanomaterials development strategy and application roadmapping to variety of private clients, including leading multinational companies, universities and government agencies. CNT has experience in organising a wide range of industrial and technology development stakeholder's engagement workshops, online and in person at a number of locations in Europe and the USA.

Guest presentations

14:45 **Sofia Sampehai,** Senior Project Leader, TWI

Title: Composites and Novel Processing at TWIs

TWI has been carrying out research and development into composite materials for over 30 years. This gives considerable breadth to our expertise, which covers all aspects of working with composites including design, modelling, processing, repair, NDT, failure analysis, joining, added functionality (coatings) and testing. The breadth of our knowledge also draws on the use of composites in the many different industry sectors with which we work, each with differing requirements and applications.
TWI is currently managing numerous collaborative opportunities related to the use of composite materials in sectors such as aerospace and automotive. This presentation will give an overview of the work that is currently being performed in four collaborative projects namely: 1) TCTool – Development of innovative tooling and end-effector for industrialisation of welding thermoplastic components, 2) TOD – Development of full scale innovative composites doors, surrounds and sub-structure for Regional Aircraft Fuselage barrel on-ground demonstrators, 3) D-JOINTS - Design of innovative composite hybrid joints with electromagnetic compatibility along with a dedicated software sizing tool and 4) PROTECT – Design, Development and testing of an innovative multi-material crash-box with better impact energy-adsorption capabilities

15:15 *Discussion*

Graphene based sensors commercialisation, opportunities and challenges

Facilitated by Bojan Boskovic, CNT, UK

16:00 *Closing remarks*

***Note** It is planned that all presentations would be followed by Q&A discussion. The organisers reserve the right to change the programme, speakers or venue should circumstances require. For any further enquires please do not hesitate to contact directly the **GRAPHOSITE Exploitation and Dissemination Manager** Dr Bojan Boskovic on info@graphosite.co.uk or Bojan.Boskovic@CNT-Ltd.co.uk or on his mobile phone +447780874335.*

GRAPHOSITE Open Day 2021 Workshop: Speakers

Dr Bojan Boskovic *(GRAPHOSITE Partner & Open Day Organiser)*
Managing Director
Cambridge Nanomaterials Technology Ltd.
14 Orchard Way
Lower Cambourne
Cambridge CB23 5BN, UK

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).

Dr George Maistros, *(GRAPHOSITE Partner)*
ADVISE-DETA
34 Castle Rd.
Bedford MK40 3PJ

Dr George Maistros is the Technical Director of ADVISE-DETA. He is a Chemical Engineer from National Technical University of Athens in 1988 and received his PhD in Advanced Materials from Cranfield University in 1991, focusing on the dielectric cure monitoring of thermoset resin systems. He has over 20 years of experience in promoting dielectric sensing systems to all kinds of material processes, such as composites processing, repair of structures, nano-membranes operation and engine exhaust fumes characterization. He has authored 15 publications in scientific journals and 1 chapter in book. He has coordinated 3 Aeronautics FP6 (COMPROME, SENARIO, NOESIS) programs on applications of dielectric technology on composites manufacturing processes.

Natalia Garban *(GRAPHOSITE Partner)*
TWI
U Granta Park, Great Abington
CB21 6ALK Cambridge

Natalia Garban is a Chartered Engineer and Project Leader at TWI in the Condition and Structural Health Monitoring team. She leads the development and application of advanced innovative inspection, assessment and risk management solutions for the Energy industry and Oil & Gas sector. Natalia is experienced in project planning, control and monitoring, milestones and resources management, product optimisation integrity management. Prior to joining TWI, she worked in Venezuela, on business development projects as the Head of strategic planning, control and budgeting of construction and renovation projects, as well as maintenance of equipment. She has a MEng in Materials Engineering and an MSc in Structural Integrity.

Dr Fokion Oikonomidis *(GRAPHOSITE Partner)*
TWI
U Granta Park, Great Abington
CB21 6ALK Cambridge

Dr Fokion Oikonomidis joined TWI as a Project Leader in January 2012 and has since developed expertise in small- and large-scale fracture toughness testing in air, seawater, and sour environments. Fokion is the quality advisor of the Materials and Structural Integrity group in Cambridge since 2014. Fokion has supervised postgraduate students in the National Structural Integrity Research Centre. During the six years before joining TWI, he worked in the area of Fracture Mechanics both in a research centre in Belgium and during his 1st PhD at the University of Bristol. Fokion is a chartered mechanical engineer with work experience in the fields of water and wastewater treatment, building services, health and safety and business process management in the aerospace industry. Fokion has served in the Hellenic Air Force and has an MBA degree in general business administration from the University of Hull. Fokion recently obtained his 2nd PhD in Management at the University of Newcastle upon Tyne.

Romilly Close *(GRAPHOSITE Partner)*
Haydale Composite Solutions
Unit 10, Charnwood Business Park,
North Road, Loughborough,
LE11 1QJ
UK

Romilly Close's joined Haydale in November 2019 as a Project Engineer, supporting a variety of projects focussing on integrating nanomaterials into aerospace and rail structures. She is currently technical lead of a European Space Agency-funded project developing non-metallic propellant tanks for low earth orbit satellites. Within Graphosite, she manages the manufacture of test samples and integration of graphene sensors into composite structures.

Akram Zitoun *(GRAPHOSITE Partner)*
Brunel Composites Centre
U Granta Park, Great Abington
CB21 6ALK Cambridge

Akram Zitoun is a Research Fellow at the Brunel Composites Centre (BCC). His current work includes design, modelling and development of technologies with relation to quality evaluation of composite either after manufacturing or during service life. His expertise lies within different non-destructive methods and structural health monitoring systems. He has expertise in designing and developing systems, develop machine learning algorithms for autonomous extraction of signal of interest and applying technical knowledge to evaluation the health of structures.

Akram gathered valuable experience by working on developing innovative systems of evaluation and assessment of aircraft composite structures and he currently is working on different projects such as GRAHOSITE. He in charge of developing the technical solutions and project management.

Dr Zlatka Stoeva *(GRAPHOSITE Partner)*
DZP Technologies Ltd.
Future Business Centre
Kings Hedges Rd
Cambridge CB4 2HY
UK

Dr Zlatka Stoeva is a managing director and founder of DZP Technologies Ltd. She developed the current product and service portfolio and initiated strategic business partnerships and collaborations to commercialise the company's innovations in flexible and stretchable electronics, wearable technology, graphene, and sensors for the Internet-of-Things. Zlatka has a scientific background in materials chemistry, having completed her PhD degree at the University of St Andrews in 2001, working on polymer electrolytes for solid-state lithium-ion batteries. She then held post-doctoral research positions working on lithium-ion conductors and other energy storage materials. In 2006, Zlatka moved on to a business focussed role at the technology transfer office at the University of Cambridge. She spent several years in this role, working on the commercialisation, patenting, and licensing of technologies arising from university science. Zlatka also holds an MBA from Nottingham University Business School and LLM International Business Law from Anglia Ruskin University.

Dr Sofia Billett *(GRAPHOSITE Partner & Open Day Organiser)*
Cambridge Nanomaterials Technology Ltd
14 Orchard Way
Lower Cambourne
Cambridge CB23 5BN
UK

Dr Sofia Billett is a Senior Innovation Consultant at CNT Ltd., working on patent landscaping, market research reports and other innovation management related activities for EC H2020 and Innovate UK projects. She has extensive R&D, project management and regulatory experience. She has a scientific research background in biochemistry, environmental microbiology and toxicology.

Guest Speakers

Sofia Sampethai *(Guest Speaker)*
TWI Ltd.
U Granta Park, Great Abington
CB21 6ALK Cambridge
UK

Sofia Sampethai received her MSc from the Swiss Federal Institute of Technology (ETH-Z) in Process Engineering and Nanotechnology. She pursued her master thesis at the IBM clean room laboratories and she has extensive experience in Nanotechnology, synthesis of nanomaterials and materials processing. She is an expert in clean room synthesis of carbon nanotubes, chemical vapor deposition,

controlled synthesis of carbon nanotubes after her three years spent at the Swiss Federal Institute of Technology in Zürich. She has worked as a Research Associate leading collaborative proposal since 2015 and since 2017 when she joined TWI, she has been working extensively on Project Management, Proposal preparation, Dissemination and Exploitation activities. Sofia has been managing successfully numerous collaborative projects ensuring the delivery of the relevant activities against time, budget and quality.

GRAPHOSITE Open Day 2021 – Partners and Participating organisations

GRAPHOSITE Partners

ADVISE-DETA

Web: www.advise-deta.com/en/

ADVISE-DETA is a recently formed SME that specialises in implementing advanced sensors to a wide range of material transformation processes, including polymer processing, composite materials manufacturing, mixing of chemicals and repair of structures. To this end, the company owns the IP (through transfer from ADVISE, Greece) of the dielectric monitoring system, which includes dielectric sensors, electronic measurement hardware and intelligent process monitoring software. The system has been installed in several industrial sites of advanced composites manufacturing. The business goal is to market the existing technology and establish new applications in modern manufacturing processes. The company's laboratory includes process characterisation methods (viscometer, optical microscope), dielectric measurement systems (frequency analyser, dielectric cure monitoring systems, material state based control prototype, temperature controlled sample holders) and software programming and modelling tools (LabView, Matlab).

Brunel Composite Centre (BCC)

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. The principal mission of BCC is to establish a world class research centre offering high quality research in phenomena that take place at the interface of composites to other materials. The physicochemical processes studies include processing of composites, embedding of smart structures in composites and joining of composites with other materials. BCC operates with the aim of developing a financially sustainable research facility, drawing on Brunel University's existing strengths, to complement and underpin the applied research and development activities of TWI.

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.

DZP Technologies

Web: www.dzptechnologies.com/

DZP Technologies is a leading developer of specialty materials, formulations, and technologies for emerging industries. We work closely with our customers to create innovative materials for a range of markets, from consumer electronics and wearables, to 3D-printing and renewable energy. Founded in 2008, we work with forward-thinking businesses and enterprises to fast-track scientific discoveries and create advanced technologies for a wide range of markets. We are happy to take on the toughest technical challenges, using our expertise to help our customers develop innovative, sustainable products which offer a true differentiator in competitive markets.

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.

GRAPHOSITE Open Day 2021 Workshop - Participating Organisations

Rolls-Royce plc.

Web: www.rolls-royce.com

Employing over 40,000 people worldwide, **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.7

ARUP

Web: www.arup.com

ARUP is an independent firm of 15870 designers, planners, engineers, architects, consultants and technical specialists, working across every aspect of today's built environment. Together we help our clients solve their most complex challenges – turning exciting ideas into tangible reality as we strive to find a better way and shape a better world.

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. 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%).

BAE Systems

Web: www.baesystems.com

At BAE Systems we provide some of the world's most advanced, technology-led defence, aerospace and security solutions. We employ a skilled workforce of 87,800 people in more than 40 countries. Working with customers and local partners, we develop, engineer, manufacture, and support products

and systems to deliver military capability, protect national security and people, and keep critical information and infrastructure secure.

The Nanoscience Centre - University of Cambridge

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.

University College London

Department of Physics and Astronomy

Web: www.ucl.ac.uk/physics-astronomy

UCL is a world-leading university situated in the heart of London, UK. UCL was 1st in the UK for research strength at the last UK university research assessment (UK REF 2014). ~40,000 undergrad+post grad students, ~7,000 Staff. The Physics and Astronomy Department at UCL is located in the heart of the historical area of Bloomsbury. Scientific research and study has been a strong feature of UCL since its inception in 1826 and the Department is one of the top rated Physics departments in the country and the world.

City, University of London

Web: www.city.ac.uk

City, University of London's five specialist Schools and over 30 departments are home to our outstanding academic departments, faculties, divisions and research centres. City prides itself on its innovative approach to education. Our courses are enriched by the research of our academic staff. 75.7% of City's submission to the Research Excellence Framework (REF) was rated as being of world leading 4* and internationally excellent 3* quality.

Radical Fibres Ltd

Web: radicalfibres.com

Radical Fibres is a newly formed micro-company which specialises in the customisation, development and manufacture of nanofibre textiles. Its current main product listing is anti-viral nanofibre filters, composite toughening veils, and featherweight smart textiles. It also specialises in nanoparticle loading of nanofibrous materials to achieve new materials and new platforms for nanomaterials delivery.

Pilkington - NSG Group

Web: www.nsg.com

NSG Group is one of the largest global flat glass manufacturers; primarily provides value-added glazing to the built environment, automotive and solar markets. We also manufacture and sell glass fibres, flakes and thin glass for a variety of end uses in consumer electronics, white goods, timing belts and composites.

Brunel University of London- Brunel Innovation Centre (BIC)

Web: www.brunel.ac.uk/research/Centres/Brunel-Innovation-Centre

Brunel University has more than 1000 academic staff, responsible for advancing teaching and research programmes.

The Brunel Innovation Centre (BIC) The Brunel Innovation Centre (BIC) is a world class research and technology centre that sits between the knowledge base and industry offering high quality research in an innovative environment focused on non-destructive testing, condition and structural health monitoring, power ultrasonics and allied technologies covering a range of materials, sensors, electronics and software systems supporting partners in industry to transfer academic research into industrial application. It has about 30 research staff members, delivering research projects in the fields of AI, SHM, and power ultrasonic.

National Technical University of Athens

Research Lab of Advanced, Composite, Nano Materials & Nanotechnology", R-Nano

Web: nanolab.chemeng.ntua.gr

The "**Research Lab of Advanced, Composite, Nano Materials & Nanotechnology", R-Nano** is situated at the School of Chemical Engineering (Department of Materials Science and Engineering) of **National Technical University of Athens (NTUA).** It was established in 2007; its research group has extensive experience in Designing, Production and Characterization of Advanced-, Composite- and Nano- Materials.

Aixtron Ltd

Web: www.aixtron.com

AIXTRON Ltd belongs to the AIXTRON group of companies which manufactures equipment for the global semiconductor market and related industries. With a team of highly motivated technologists and engineers, the company has grown in capability and reputation to become one of the world's leading supplier for semiconductor equipment. AIXTRON Ltd in Cambridge focusses on the development, design build and test of R&D scale MOCVD systems for semiconductor applications. Within AIXTRON Ltd resides the NanoInstruments department, which is responsible for the large scale implementation of graphene and carbon nanotube growth and transfer technology.

Long Road Sixth Form College

Web: www.longroad.ac.uk

Long Road Sixth Form College (LRSFC) is a public sector co-educational sixth form college in Cambridge, England, with 2300 students. The College provides full-time A level courses in addition to Level 3 Diploma courses, Level 2 Diploma courses and GCSE consolidation courses.

Q5D Technology Limited

Web: q5dtech.com

Q5D is a new company that has developed robotic tools that add electrical function to existing components by using additive manufacturing, laser-sintered printed electronics and embedded wiring. The company works primarily with the aerospace and automotive sectors but is also targeting the whitegoods market. It has less than 10 employees but is growing.

National Physical Laboratory

Web: www.npl.co.uk

NPL is the UK's National Metrology Institute, developing and maintaining the national primary measurement standards. NPL is part of the National Measurement System (NMS) which provides the UK with a national measurement infrastructure and delivers the UK Measurement Strategy on behalf of BEIS. We undertake excellent science and engineering to deliver extraordinary impact for the UK and provide the measurement capability that underpins the UK's prosperity and quality of life. From accelerating new antibiotics and more effective cancer treatments to developing unhackable quantum communications and superfast 5G, our expertise is crucial in researching, developing and testing new products and processes.

EMPA

Web: www.empa.ch

As an interdisciplinary research institute, **EMPA,** the Swiss Federal Laboratories for Materials Science and Technology, conducts cutting-edge materials and technology research. Its activities focus on the requirements of industry and the needs of society, and thus link applications-oriented research to the practical implementation of new ideas. Through an efficient technology transfer EMPA is turning research results into marketable innovations.

Institute of Occupational Medicine - IOM

Web: www.iom-world.org

IOM is a research organisation with over 50 scientists working at multi-disciplinary area. Although established in 1969, From early 2005, we became a leading player in Europe into collaborative research

related to the safety of nano-sized materials, developing an leading a series of projects. We also established SAFENANO, funded by the UK Government, as the first centre of excellence to support and de-risk emerging industrial applications of nanomaterials. We have evolved and changed in many ways but the two founding questions from our original research on lung disease in coal workers can be generalised as;

- How much and what kinds of exposure cause health effects?
- What levels of exposure need to be maintained to prevent health effects occurring?
- It's these two questions that still define our purpose and why we exist as an organisation today.

Trelleborg Applied Technologies

Web: www.trelleborg.com/en/applied-technologies

Trelleborg Applied Technologies is an industry expert in delivering innovative and reliable solutions that maximize performance for our customers. Our vast range of specialized, customizable materials ensure peace of mind at every stage of your project. With reliable and efficient project management and manufacturing we endeavor to take performance to new levels by achieving your goals safely, on time and within scope.

Stellenbosch University

MTN Mobile Intelligence Lab

Web: mtn.sun.ac.za

The **MTN Mobile Intelligence Lab** is a multidisciplinary environment where engineering solutions are developed and research contributions are made that is relevant to everyday problems encountered. The academic focus of the lab is to explore the next frontier in IoT, mobile technology and computing, telemetry and cloud computing.

New Industry Research Organization - NIRO

Web: http://www.niro.or.jp/profile_english/

The New Industrial Creation Research Organization (NIRO) was established in 1997 with the aim of promoting creative industries with an eye to industrial reconstruction and medium- to long-term after the Great Hanshin-Awaji Earthquake, and we will make use of the experience gained at this time to firmly support companies in the current economic crisis. Niro aims to create a region through the creation of new industries while taking a close view of social trends, focusing on the four fields of future industries that are expected to grow at a high level, especially taking advantage of the vitality of the local community, such as "environment and energy", "DX (digital transformation)", "health and medical care", and "aviation and space", as well as the characteristic "regional industries", and we are strengthening the technical foundations of manufacturing and intellectual property.

Kawasaki Heavy Industries, Ltd.

Web: https://global.kawasaki.com/

Together with about 100 group companies in Japan and overseas, **Kawasaki Heavy Industries** oversees the formation of a "technology corporate group." Our technological capabilities, polished over a history that exceeds a century, send diverse products forth into wide-ranging fields that go beyond land, sea, and air, extending from the ocean depths to space. Our aerospace division is active in products ranging from aircraft to satellites. The products that our rolling stock division delivers to the world include Shinkansen and New York subway cars, while our ship and offshore structure division's products range from gas carriers and large tankers to submarines, and our energy solutions division covers the spectrum from development and manufacture of energy equipment to management systems. We are also active in wide-ranging businesses driven by diverse and high-level engineering technologies, including environmental and recycling plants, industrial plants, precision machinery, industrial robots, and infrastructure equipment. Finally, we operate our leisure and power products business that features the motorcycles known as the Kawasaki brand. Through the development of unique and broad businesses unmatched elsewhere, we will continue to create new values that solve the issues facing our customers and society.

TOYOBO CO., LTD.

Web: www.toyobo.co.jp

TOYOBO Co Ltd, specialises on the development and manufacture of high-performance products, mainly in the textile, chemical, biotechnology and pharmaceutical industries.

Cambridge University - Engineering Department

Web: www.eng.cam.ac.uk/

The **Department of Engineerin**g is one of the few truly integrated engineering departments in the world. It is also the largest department in **the University of Cambridge**. Its breadth and scale bring unique advantage. The research portfolio develops pinnacles of world-class excellence, which adapt and combine to address a vast array of engineering challenges. Graduate teaching brings students into the heart of the latest research and developments. The undergraduates gain a strong foundation in all engineering disciplines together with in-depth knowledge of their chosen specialist field. Across research, teaching and graduate study, the Department of Engineering offers all its staff, students and industry partners a highly networked community for sharing and developing engineering knowledge.

Nippon Steel Corporation

Web: www.nipponsteel.com/en

Nippon Steel Corporation is focussed on steelmaking and steel fabrication / Engineering / Chemicals / New materials / System solutions.

Nippon Steel Corporation Group will pursue world-leading technologies and manufacturing capabilities, and contribute to society by providing excellent products and services.