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## NANOMAT<sup>3D</sup> 2020 WORKSHOP

Workshop on Nanomaterials for 3D Printing

*Post-Event Report v1.1*

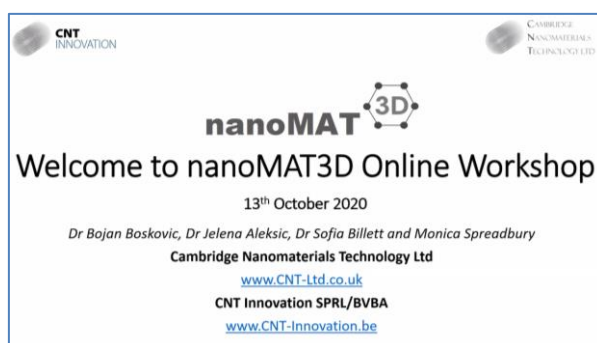
[www.cnt-innovation.com/nanomat3d\\_workshop](http://www.cnt-innovation.com/nanomat3d_workshop)

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**Date:** 13th October 2020

**Meeting Venue:** ZOOM digital platform



ORGANISED BY:



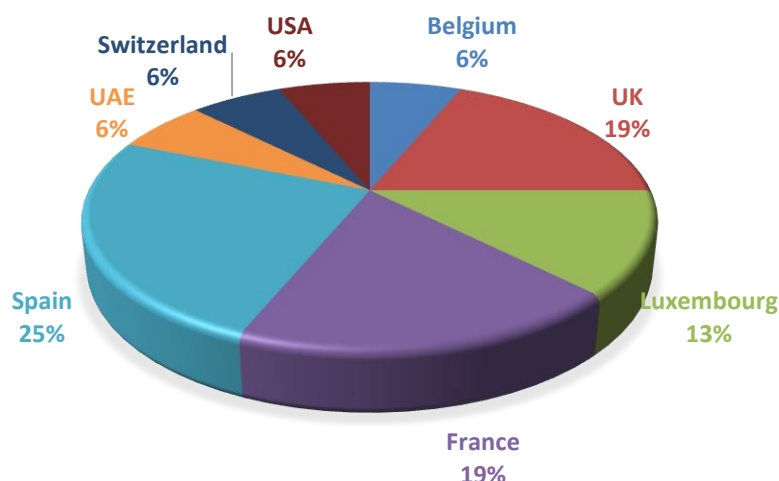
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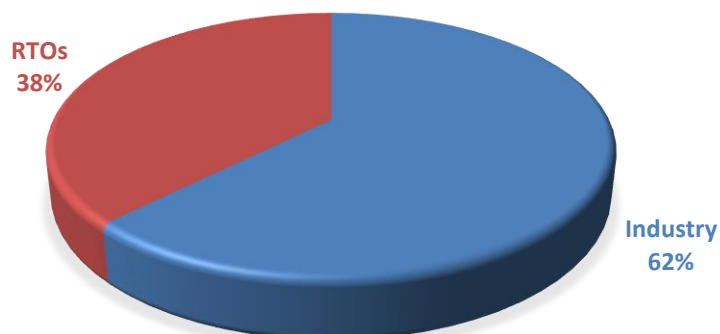
## SUMMARY

**CNT Innovation** together with its sister company, **Cambridge Nanomaterials Technology Ltd (CNT)** organised the **Nanomaterials for 3D Printing 2020 Workshop (nanoMAT<sup>3D</sup>)** in order to support commercialisation of use of nanomaterials in development of polymer and metal based composite technologies for additive manufacturing. The Nanomaterials for 3D Printing Workshop was an opportunity to learn about progress in development of nanomaterials, new additive manufacturing technologies and progress in use of nanomaterials in additive manufacturing applications. It was also a platform to bring together technology development leaders and industrial end-users in order to exchange experience between technology developers in industry and researchers in academia working on nanomaterials and additive manufacturing. **Cambridge Nanomaterials Technology Ltd** held the 1<sup>st</sup> **nanoMAT<sup>3D</sup>** in on the 10<sup>th</sup> -11<sup>th</sup> July 2019 at Wolfson College, in Cambridge, UK. Around 50 people participated in this workshop, coming from leading manufacturing and research organisations such as: ARUP, ArcelorMittal, Prysmian Group, RTE France, Mitsubishi Heavy Industries Europe, Additive Industries b.v. Aurubis, MBDA, Leitat Technological Centre, Eurecat, Coatema, E.G.O. Elektro-Gerätebau, Brunel Innovation Centre, TWI, Haydale, IMDEA and universities: National University of Singapore, University of Surrey, University of Cambridge and UCL, among others. The 2<sup>nd</sup> **nanoMAT<sup>3D</sup> Workshop** was held online on the 13<sup>th</sup> October 2020, with the participation of around 24 delegates coming from 16 leading organisations, such as: **Rolls Royce, Whirlpool Corporation, ArcelorMittal, LEITAT, ACCIONA, European Synchrotron (ESRF), Lucideon, Mesa Consult, AM 4 AM, IPC – Innovation Plasturgie Composites, Eurecat, EMPA, Hummink and CIC nanoGUNE.**

### PARTICIPATING ORGANISATIONS BY COUNTRY



### TYPE OF PARTICIPATING ORGANISATIONS



## FEEDBACK FROM PARTICIPANTS

***“I just want to thank you again for inviting us to the meeting. I really found it very interesting.”***

Global R&D  
ArcelorMittal

***“Thank you very much for the opportunity to attending to this workshop and the very interesting presentations”***

Senior Researcher Engineer  
LEITAT

***“Thank you very much for all the very interesting talks”***

Ceramics Engineer  
Lucideon

***“Thank you everyone for great discussions and a special one to Bojan, Jelena and Mónica for organising this event”***

Project Manager  
LEITAT

***“Thank you very much for the invitation, I am sure we will have the opportunity to collaborate. Many thanks also to the presenters for their very interesting research and development work”***

Head of Innovation and Technology  
LEITAT

***“Thank you very much for the very interesting workshop. I really enjoy the format”***

Deputy Head of Business Development  
ESRF

***“Thank you for this really interesting workshop”***

CEO  
AM 4 AM

## LIST OF PARTICIPATING ORGANISATIONS

Organisation	Country
ACCIONA	UAE
AM 4 AM	Luxembourg
ArcelorMittal	Spain
Cambridge Nanomaterials Technology Ltd	UK
CIC nanoGUNE	Spain
CNT Innovation	Belgium
EMPA	Switzerland
Eurecat	Spain
European Synchrotron (ESRF)	France
Hummink	France
IPC - Innovation Plasturgie Composites	France
LEITAT	Spain

<b>Lucideon Ltd.</b>	UK
<b>Mesa Consult</b>	Luxembourg
<b>Rolls Royce</b>	UK
<b>Whirlpool Corporation</b>	USA

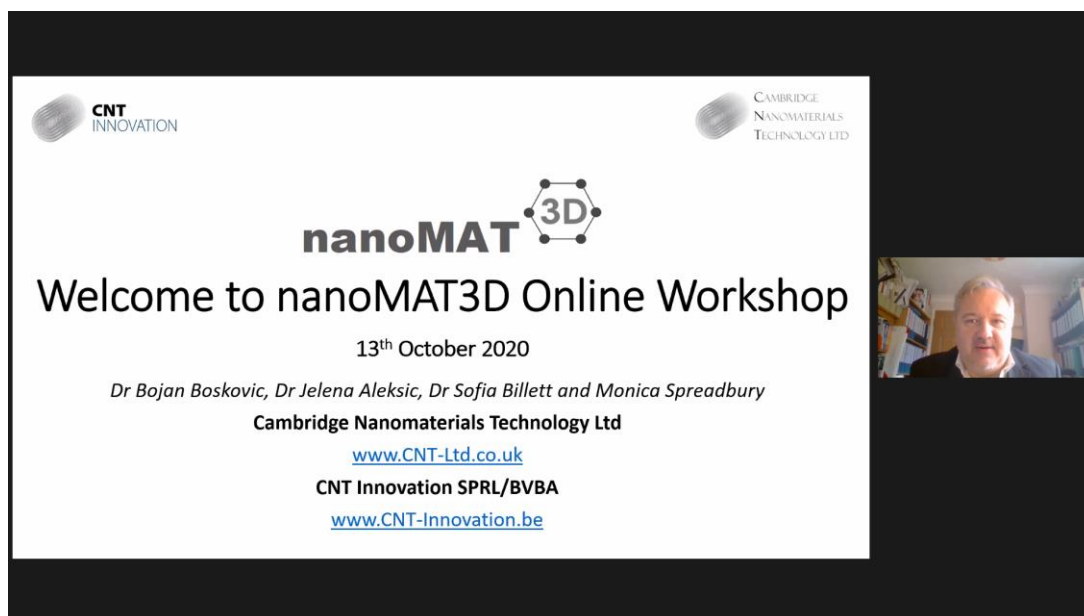


## NANOMAT<sup>3D</sup> 2020 WORKSHOP

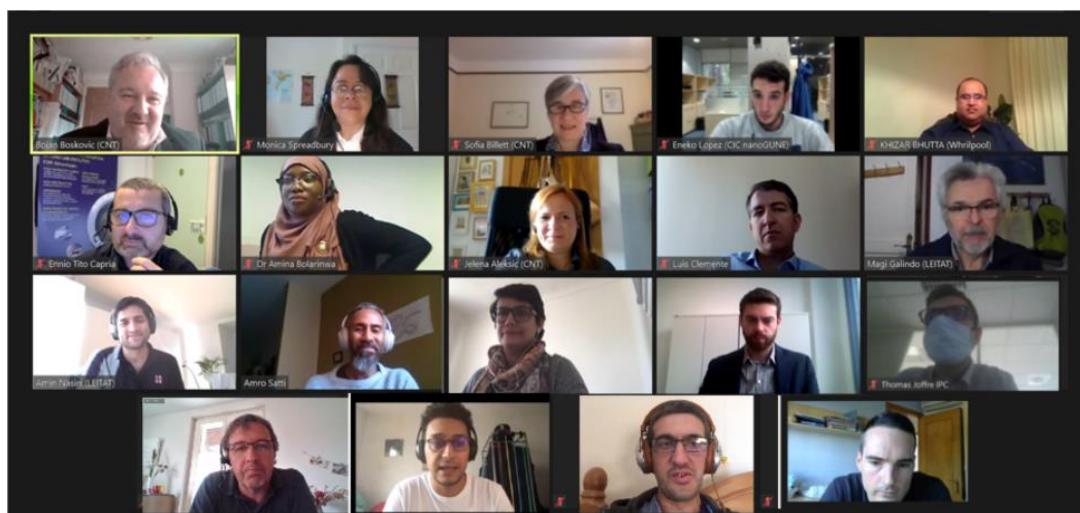
### AGENDA NANOMAT<sup>3D</sup> 2020 WORKSHOP

#### 09:30 Welcome and Introduction to the Nanomaterials for 3D Printing 2020 Workshop

**Dr Bojan Boskovic**, CEO, CNT Innovation & CNT Ltd.



#### 09:45 Individual Introduction of all participants



#### 10:30 **Dr. Ennio CAPRIA**, Deputy Head of Business Development, European Synchrotron (ESRF), France

**Title: How the use of synchrotron characterisation can help addressing the grand challenges of Metals Additive Manufacturing**

Additive manufacturing, often called 3D printing, represents one of the major innovations in the world of engineering and manufacturing. It is extremely promising because it offers the



possibility to revolution the manufacturing industry with more cost-effective and environmentally friendly methodologies and definitely novel structures and designs. Nonetheless, AM is not yet largely adopted due to uncertainty around the performance and reliability of the final product. Exactly as in the case of laser welding, where a laser beam is responsible to melt materials in order to join parts, the additive manufacturing process involves the melting of metal powder using a laser beam, to create a 3D object. Very complex shapes and geometries are possible, as well as new materials, with potential applications in all industries from aerospace to automotive. However, differently from the normal manufacturing process, where the material can cool down and solidify in several seconds or minutes, in the additive manufacturing process the melting and cooling phases can be as fast as about 10 milliseconds, i.e. up to 1000 times faster. These extreme conditions can drastically affect the microstructure, and therefore performance, of the material. As a consequence, often, the properties of the material are not compliant with the specification and the tenure in time (fatigue) do not respect the predictions. Synchrotron characterisation can offer a unique insight to better understand the AM related phenomena, in order to be able to design more efficient systems and materials. Synchrotron X-rays, with their very high flux can offer the possibility to see how the materials changes in real time. Images realised at a record speed of 1000 frames per second of the inside of the AM system, can allow to understand the exact dynamic of the material melting and solidification and of the powder dispersion. The researchers need this in order to see the real time effect of temperature at this timescale. Furthermore, high energy synchrotron X-rays diffraction methodologies can allow the possibility to measure local residual stress gradients that can offer a key for understanding the AM made parts performances, with respect to the manufacturing methodology and parameters, also in relation with the microstructure.



**11:00 Luis Clemente, COO 3D Printing, Construction, ACCIONA, UEA**

**Title: Concrete Large-Scale 3D Printing. A New Era in Construction and Architecture**

3D Printing is a technology with potential to disrupt almost every single industry, and construction is not an exemption. As part of one of the less digitized sectors, construction companies are starting to find applications of advanced technologies such as Internet of Things, Artificial Intelligence, Augmented and Virtual Reality, Autonomous vehicles, Inspection Drones and 3D Printing. With infinite applications, materials and scales, 3D Printing can help the construction in many ways. One of them is the large-scale concrete 3D Printing which brings automation, freedom of shapes, safety, speed, sustainability and cost reduction as main advantages. Two main processes are applied for this, namely extrusion and powder-bed with applications in singular structures, sculptures and replicas, buildings, and urban furniture.





**11:30 Dr Amin M'BARKI, CEO and Co-Founder, Hummink, France**

**Title: Hummink - Additive manufacturing at the nanoscale**

Hummink is a newly created spinoff from ENS Paris and Institut Pierre Gilles de Gennes. After years of research and patenting in these academic institutions, Hummink develops a direct additive manufacturing technology, with unique versatility, precision, and resolution. Through direct deposition of various liquids (polymers, gels, colloids, Qdots...), you can design complex patterns with resolutions down to a few tens of nanometers. Hummink addresses the issue of freedom of design, with high versatility, in a resolution range that is very competitive, and allows deposition of highly complex patterns. Semiconductor, molecular diagnosis, and the screen manufacturing are examples of markets that can benefit from our technology.



**12:00 Dr Amina Bolarinwa, Senior Materials Engineer, Lucideon Ltd, UK**

**Title: Ceramic Additive Manufacturing Development at Lucideon**

Additive manufacturing enables the flexible production of highly complex and or precise structures. These are structures that are difficult or impossible to produce using conventional

manufacturing techniques such as slip casting, extrusion and pressing. Additive Manufacturing frees producers from the time and cost restraints associated with new mould design, manufacture and storage. It also reduces reliance on green machining and the significant material loss created. Lucideon has been exploring and developing expertise in a range of additive manufacturing technologies; two of which includes robocasting and powder bed ink binder jetting. These techniques have been prioritized based on the potential to minimize the use of organics that require removal after shaping. Robocasting is a relatively simple 3D printing technology which uses extrusion of a continuous viscous ceramic paste to print parts. It is best suited for printing mechanised coiled geometries with little or no polymer present and thereby removing the issues associated with long debinding regimes. The parts can be printed on a robocasting printer with no need for a support as can be found in stereolithography. Rheological control is of significant importance to prevent the deformation of parts printed after extrusion. Robocasting is especially key for traditional ceramic formulations where the correct level of water combined with plastic clays provides the correct rheology for controlled extrusion. Powder bed binder jetting technology provides more flexibility and definition to the printed structure than robocasting. A ceramic powder has to be characterised and optimised to ensure it flows, spreads and packs uniformly as a dry powder layer on a growing built layer. The ink to be jetted from the print head onto the powder bed also needs to be formulated and optimised. Lucideon successfully produced a high wt% alumina ceramic ink which was compatible with a chosen/specified print head for jetting onto a ceramic powder bed. The ink provides both green strength to the growing printed structure and reduced porosity / increased strength upon subsequent sintering.



**12:30 Marc Crescenti & Miquel Domingo Espin, Eurecat, Spain**

**Title: CFIP technology: a new approach for manufacturing continuous carbon fibre reinforced structures by 3D printing.**

The Continuous Fibre Injection Process is a new post-process technology which enables to reinforce additive manufactured parts with continuous fibres. In CFIP the fibres trajectories are defined by the trajectories of tubular cavities, which can be freely designed in all directions and manufactured with no limitations thanks to additive manufacturing. In this way, CFIP enables to align the fibres to the most efficient directions following complex trajectories, so that highly optimised structures with improved mechanical and light-weighting performance can be obtained. This new capability makes the design and optimization process highly challenging, since not only the AM region needs to be optimized but also the fibres trajectories inside the part. In addition, the resulting part is highly orthotropic and specific material models and failure criteria for composite materials need to be used. In order to address this, Eurecat has developed a new design and optimization methodology involving two topology optimization steps, which has been successfully applied in different case studies. The speech will be focused on explaining how CFIP technology works, including case studies developed in collaboration with companies aimed to demonstrate the potential of the technology in different sectors and

applications. CFIP technology website: <https://eurecat.org/en/differential-technologies/cfip-carbon-fiber-for-3d-printing/>



13:00 Borja Batlle, LEITAT, Spain

#### Title: AM/3DP R+D+I in Leitat - ON THE BASIS OF INDUSTRIAL NEEDS

The activities of an industrial company are part of the links in the value chain of a product. The productive industry usually incorporates activities of product design and development, industrialization, production, validation, logistics, sales and technical assistance and maintenance of the product on the market throughout its life cycle. Each of these links present specific requirements from the technological point of view and new research and development challenges to face them more efficiently, so that the company can innovate, grow, and generate profits. Additive manufacturing is currently an alternative for final production. Production implies, among other things, productivity, quality, compliance with specifications and standards to be introduced into the market... and all these requirements involve research and development of technologies to meet these needs: planning and control software, improvement of production systems, development of new materials, automation of operations, quality control systems, etc. From Leitat, research, development, and innovation in additive manufacturing / 3D printing, are faced as a matter of industrial necessity, to respond to these technological challenges. Leitat bases its strategy and roadmap for its research and development activities and its innovation projects in the service of industry based on current and future needs of the industries from of product design to production.

**From LEITAT and IAM3DHub**

How can additive manufacturing help companies to become more efficient, innovate and grow?

Leitat, founded in 1906, is a private and non-profit technological centre.

Placed in Terrassa, 35 km north-west of Barcelona.

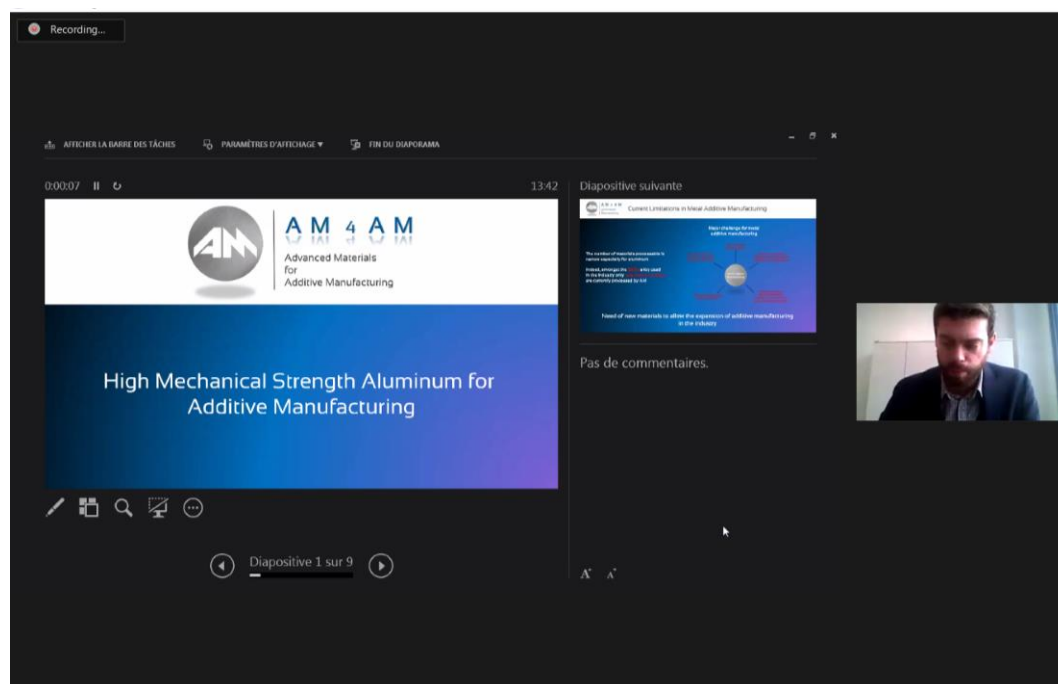
It is recognized by the Catalan Government (TECNIO) and by the Spanish Ministry of Science and innovation.

**Borja Batlle**

13:30 Dr Maxime Delmée, AM 4 AM, Luxembourg

### Title: High Mechanical Strength Aluminium for Additive Manufacturing

Additive Manufacturing (AM) is an emerging and proliferated worldwide technology for the processing of complex parts of a wide range of materials which cannot be processed by conventional manufacturing. This technology attracts the particular interest of the aeronautic and aerospace sectors. Although, some technological issues at the materials level have to be overcome to continue the expansion of this technology. Indeed, AM processes using high energy beam (laser or electron beam) still exhibit some major challenges especially when applied to metal or metal alloy powders. Only few metal or metal alloy powders out of the more than 5000 used in the industry can be additively manufactured nowadays. Amongst the main challenges, it can be pointed out the high reflectivity of metal powders, the oxidation of some alloys, the formation of microstructures with cracks, voids and defects and eutectic or peritectic decomposition of some alloys. Most aluminium alloys are not processable by additive manufacturing because of these limitations. AISi10Mg is one of the only aluminium alloys processable by this technology but its mechanical properties are out of the specifications required by aeronautic manufacturers. High mechanical strength aluminium alloys own the potential to become one of the most sought-after materials in AM for aeronautic and aerospace applications. Indeed, aluminium thanks to its light weight and cheaper price compared to titanium and nickel superalloys attracts a lot of attention to replace heavier parts in aircrafts and helicopters. The ambition of AM 4 AM is to produce high mechanical strength aluminium alloy powder (similar to Al 7075 or 6061) for additive manufacturing and especially aeronautic, aerospace and automotive applications via an innovative technology. AM 4 AM filed a patent on powders modification by grafting of smaller particles on the surface of particles powder by atmospheric plasma discharge. This technology aims to produce high mechanical strength aluminium alloys crack free and fully dense structure with tensile strength around 500 MPa. AM 4 AM's technology aims at dispersing some small particles acting as grain refiner, nucleants, oxidation barrier onto the surface of conventional metallic powder to confer them additional properties and defects-free processability by additive manufacturing. The major principle is to inject directly particles and powders in the plasma discharge or in the downstream region, called afterglow region. The energy provided by the plasma will allow to disperse the particles onto the surface of powders. AM 4 AM first focus will be brought on the development of high mechanical strength aluminium alloy based on the functionalization of Al 7075 powder (50 – 70  $\mu\text{m}$ ) by zirconium hydride particles (1  $\mu\text{m}$ ) by plasma discharge. This treatment aims to reduce powders reflectivity, surface powder oxidation, cracks, voids and defects formation and eutectic or peritectic decomposition.



#### 14:00 Panel Discussion: "Advance Materials and Additive Manufacturing"

*The aim of the panel is to discuss frontiers of technology development in Additive Manufacturing at large scale and nanoscale. It will also discuss challenges related to Additive Manufacturing scale-up, characterization and meeting industrial needs.*

*Facilitated by **Dr Bojan Boskovic**, CEO, CNT Innovation & CNT Ltd*

*Panellists: **Dr Amro Satti**, LEITAT, Spain*

***Dr. Ennio CAPRIA**, Deputy Head of Business Development, European Synchrotron (ESRF)*

***Luis Clemente**, COO 3D Printing, Construction, ACCIONA, UEA*

***Dr Amina Bolarinwa**, Senior Materials Engineer, Lucideon Ltd, UK*

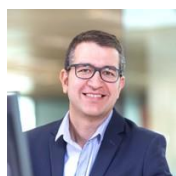
14:30 End of session

### NANOMAT3D 2020 WORKSHOP – SPEAKERS



**Dr. Ennio CAPRIA** (Speaker & Panellist)  
Deputy Head of Business Development  
ESRF  
France

**Dr. Ennio CAPRIA** gained his PhD in Applied Physics at Cranfield University (UK). In his research career he has worked on the development of nanobiosensors and on nanocomposites. In 2011 Ennio joined Elettra where he worked on manufacturing of optoelectronic devices and particularly their characterisation with synchrotron light. In 2013 Ennio joined ESRF as the IRT NanoElec Industrial Liaison Engineer and in 2016 became the Deputy Head of the BDO.



**Luis Clemente** (Speaker & Panellist)  
COO 3D Printing  
Construction  
ACCIONA  
UAE

**Luis Clemente** is a Civil Engineer highly committed to the innovation. He graduated in 2000 in Venezuela, where he was born. After 8 years working in construction projects as a Site engineer and Project supervisor, He moved to Spain to work in the R&D technology center of ACCIONA Infraestructuras. Throughout 4 years He was a manager in the Implantation area, taking those technologies been developed by the researchers to the sites and projects of ACCIONA as a link between R&D and production area. The most relevant job carried out during this period was as Site engineer of the world's first stress-ribbon type bridge using carbon fiber cables. After this, he was transferred to the Innovation area of the Corporate Division of ACCIONA. During this period, I worked on several innovation projects involving all the companies of the group, applying technologies of Mixed Reality and the development of ACCIONA's large-scale concrete 3D printing technology that was applied on the flagship project for the construction of the world's first 3D Printed concrete bridge. Most recently He supervised the launch of ACCIONA's new commercial solution for 3D concrete printing in Dubai, where He is currently the COO.





**Dr Amin M'Barki** (*Speaker*)  
CEO and Co-Founder  
HumminK  
France

**Amin M'Barki** is the CEO and Co-Founder of HumminK. After a degree in chemical engineering at INSAT (Tunis), he graduated with Master (UPMC Paris) and a PhD in Material Science from the University of Lyon, where he worked on the additive manufacturing of bioinspired ceramics. He then pursued with a postdoc at ENS Paris, under the supervision of Lydéric Bocquet, on various scale up and industrialization topics.



**Dr Amina Bolarinwa** (*Speaker & Panellist*)  
Senior Materials Engineer,  
Lucideon Ltd,  
UK

**Dr Amina Bolarinwa** is an experienced and solution focused senior technical project management and research consultant with in-depth knowledge and a strong track record of leading teams in shaping and delivering complex technical research, process transformation and business change project and programmes. A deep understanding of the need for successful collaboration with stakeholders and senior management of global corporations and leading industry experts in the healthcare, ceramics and manufacturing sectors, in the UK, Europe and the USA. A team player with valuable problem solving, negotiation, communication and decision-making skills with proven expertise to successfully deliver projects on time and budget for clients.



**Marc Crescenti** (*Speaker*)  
Fundació Eurecat  
Barcelona Area,  
Spain

**Marc Crescenti** is an industrial engineer specialized in mechanical engineering at the Polytechnic University of Catalonia (UPC). He also holds a master degree focused on design and simulation of composite structures at AMADE Research Group. His scientific and technical expertise is mainly focused on: design and optimization of composite material structures by FEA, DoE and Matlab, making use of advanced in-house tools to compute phenomena such as progressive damage; Design for Additive Manufacturing, using advanced design methods such as generative design at multi-scale level or topology optimization; CFD simulations, modelling cases such as flows in porous media or multiphase flows. He has +10 years of expertise in industry applied R&D projects. He is the creator of the CFIP technology and the responsible of its technological development at Eurecat.



**Borja Batlle** (*Speaker*)  
LEITAT  
Calle de la Innovació, 2  
Terrassa 08225  
Barcelona – Spain

**Borja Batlle** graduated in Industrial Engineering and Master specialized in Mechanics from IQS School of Engineering. During the study period was trained in different areas of computer-aided design (CAD and CAM) in CATIA and SolidWorks, Simulation (ANSYS), study and calculation of reinforced concrete and steel structures and advanced manufacturing processes and an intensification on additive manufacturing and composite materials. The final Master Project made deals with the study and design of lattice structures, sandwich type, with composite materials and additive manufacturing, with aeronautical applications. Before joining the LEITAT Technology Center he worked as Support to Key

Account Manager at technical sales department in conducting industrial offers in Galvarplast Automotive. Borja Batlle has been working at LEITAT Technological Center at the Devices Design & Engineering department as a Junior Researcher Engineer in Additive Manufacturing on topological optimization materials development and new suitable applications. Currently, is Senior Researcher Engineer in the Additive Manufacturing and 3D Printing department, working on R&D projects, industrial innovation, and new applications.



**Dr Maxime Delmée** (*Speaker*)

AM 4 AM  
Luxembourg

**Dr Maxime Delmée** Maxime Delmée started his academic career at UNamur by obtaining a master in chemistry. During his PhD studies at the Luxembourg Institute of Science and Technology (LIST) and the University of Haute Alsace (UHA) he developed an innovative method to synthesize hybrid nanocoatings. He is a material scientist specialized in laser synthesis of nanomaterials and atmospheric pressure plasma treatment. He has published several papers in plasma and physical chemistry journals. Maxime Delmée is the founder and the CEO of AM 4 AM start-up, located in Luxembourg and dedicated to the development of new materials for additive manufacturing.



**Dr Amro Satti** (*Panellist*)

LEITAT Technological Center  
Calle de la Innovació, 2  
Terrassa 08225  
Barcelona – Spain

**Dr Amro Satti** obtained his degree in chemistry from University College Dublin where he also completed his PhD in Nanochemistry. He worked as postdoctoral fellow in the Center for Research on Adaptive and Nanostructures and Nanodevices (CRANN), Trinity College Dublin where he worked on carbon nanomaterials and nanocomposites. Currently, he is an International Projects Manager at LEITAT Technological Centre, a renowned research centre located in Barcelona, Spain that collaborates with both industry and academic institutions in research, development and industrial innovation. He is one of the lead writers for grant proposals in the area of nanotechnology working on cutting edge and innovative research proposals in multidisciplinary areas.



**Dr Bojan Boskovic** (*Speaker and Organiser*)

CEO,  
CNT Innovation - Brussels  
Cambridge Nanomaterials Technology - 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 Characterisation 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 consortium: Nano-Carbon Enhanced Materials (NCEM) and Advance Materials for Additive Manufacturing (AMAM).

## NANO<sup>3D</sup>MAT 2020 WORKSHOP - ORGANISERS

### CNT INNOVATION

Web: [www.cnt-innovation.com](http://www.cnt-innovation.com)



The **CNT Innovation SPRL/BVBA** is an innovation management and technology consulting company based in Brussels (Belgium company registration number: 0723.767.874). The company was opened in March 2019, with an aim to create support and provide better services for our European customers and complement the work of its sister company, Cambridge Nanomaterials Technology Ltd. (based in Cambridge, UK). CNT Innovation is providing services related to support in research and development, technological innovation (especially in the field of nanotechnology, advanced materials and biotechnology), intellectual property rights, market research and strategy, organising conferences, seminars, workshops, training courses.

### CAMBRIDGE NANOMATERIALS TECHNOLOGY LTD (CNT)

Web: [www.cnt-ltd.co.uk](http://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.

## NANO<sup>3D</sup>MAT 2020 WORKSHOP - PARTICIPATING ORGANISATIONS

### ROLLS-ROYCE PLC.

Web: [www.rolls-royce.com](http://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.

## WHIRLPOOL CORPORATION

Web: [www.whirlpoolcorp.com](http://www.whirlpoolcorp.com)

**Whirlpool Corporation** (NYSE: WHR) is the world's leading major home appliance company, with approximately \$20 billion in annual sales, 77,000 employees and 59 manufacturing and technology research centers in 2019. The company markets Whirlpool, KitchenAid, Maytag, Consul, Brastemp, Amana, Bauknecht, JennAir, Indesit and other major brand names in nearly every country throughout the world.

## LEITAT TECHNOLOGICAL CENTER

Web: [www.leitat.org](http://www.leitat.org)

**LEITAT** is a private non-profit Technological Centre specialized in production technologies and develops R&D activities in the areas of advanced materials, environment, human and environmental health and safety, biotechnologies and renewable energies with deep knowledge and experience in technological transfers to several industrial sectors. LEITAT is recognised by the Spanish Government as a CIT (Centre of Technological Innovation). It is also a member of FEDIT (Federation of Technological Centres in Spain) and the IT Network of the Catalan Regional Government.

## THE EUROPEAN SYNCHROTRON RADIATION FACILITY (ESRF)

Web: [www.esrf.eu](http://www.esrf.eu)

The **ESRF** is the world's most intense X-ray source and a centre of excellence for fundamental and innovation-driven research in condensed and living matter science. Located in Grenoble, France, the ESRF owes its success to the international cooperation of 22 partner nations, of which 13 are Members and 9 are Associates.

## ARCELORMITTAL

Web: [corporate.arcelormittal.com/](http://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.

## ACCIONA

Web: [www.acciona-infraestructuras.es](http://www.acciona-infraestructuras.es)

**ACCIONA** is one of the foremost Spanish business corporations, leader in the development and management of infrastructure, renewable energy, water and services. Listed on the selective Ibex-35 stock exchange index, it is a benchmark for the market. The Company was set up over a century ago and is made up of more than 30,000 employees and has a presence in more than 30 countries on five continents.

## MESA-CONSULT

Web: [www.mesa-consult.eu/](http://www.mesa-consult.eu/)

**MESA CONSULT** is a Material Science & Engineering Consulting company, providing solutions to your new R&D challenges or product development. As a complement to your in-house resources MESA CONSULT can assist your company in Advanced Materials manufacturing and characterization developed for a wide field of applications.

## AM 4 AM

Web: [www.am-4-am.com](http://www.am-4-am.com)



**AM 4 AM** is a young start-up founded by Maxime Delmée. Activities of AM 4 AM are focused on the optimization of high mechanical strength aluminum alloy powders (similar to Al 7075 and Al 6061) adapted to additive manufacturing needs especially in accordance with aeronautic, aerospace and automotive sectors requirements.

## EMPA

Web: [www.empa.ch](http://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.

## LUCIDEON

Web: [www.lucideon.com](http://www.lucideon.com)



**Lucideon** is a world leader in the field of Industrial Materials Sciences & Technology. Its business covers consultancy, contract R&D and testing & analysis. It is a well-known consultancy company with over 60 years history and employs over 200 professional scientists and engineers to serve worldwide clients with speed and simplicity to improve profitability and competitive position. Six major services are: Aerospace, Ceramics, Construction, Healthcare, Nuclear and Power Generation.

## HUMMINK

Web: <https://fr.linkedin.com/company/hummink>



**Hummink** has developed a unique nanoprinting method - fast, precise, versatile and cheap. Hummink is a spinoff from Institut Pierre-Gilles de Gennes (IPGG) & Ecole Normale Supérieure (ENS), CNRS and PSL University.

## IPC - INNOVATION PLASTURGIE COMPOSITES

Web: <https://ct-ipc.com/>



**ICP** is an Industrial Technical Centre whose expertise is dedicated to innovation in plastics and composites in France. Created in 2016, it provides the profession with new means to accompany all businesses, including VSEs and SMEs and regardless of the process used, thanks to a contribution established to finance R&D, innovation, and the transfer of technology and skills. IPC is established in Oyonnax and Chambéry. The Laval, Alençon and Clermont-Ferrand sites have been newly incorporated in 2017. IPC has a national scope and is represented throughout the nation. IPC is supported by the Federation of Plastics and Composites and its Professional Organisations. IPC develops partnerships with all technical and scientific stakeholders: competitiveness clusters, technical centres, universities and engineering schools.

## EURECAT



Web: [eurecat.org/en](http://eurecat.org/en)

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

## CIC NANO GUNE

<http://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.

## CONTACT INFORMATION

If you are interested in joining the **nanoMAT<sup>3D</sup>** community and get more information, please contact us at:

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