

The overall objective of the MASTRO project is to develop intelligent bulk materials for the transport sector incorporating self-responsive properties



MASTRO

Newsletter

Issue 6 August 2021

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From nanomaterials and manufacturing know-how to building self-responsive materials for the aerospace, automotive, and transport sectors



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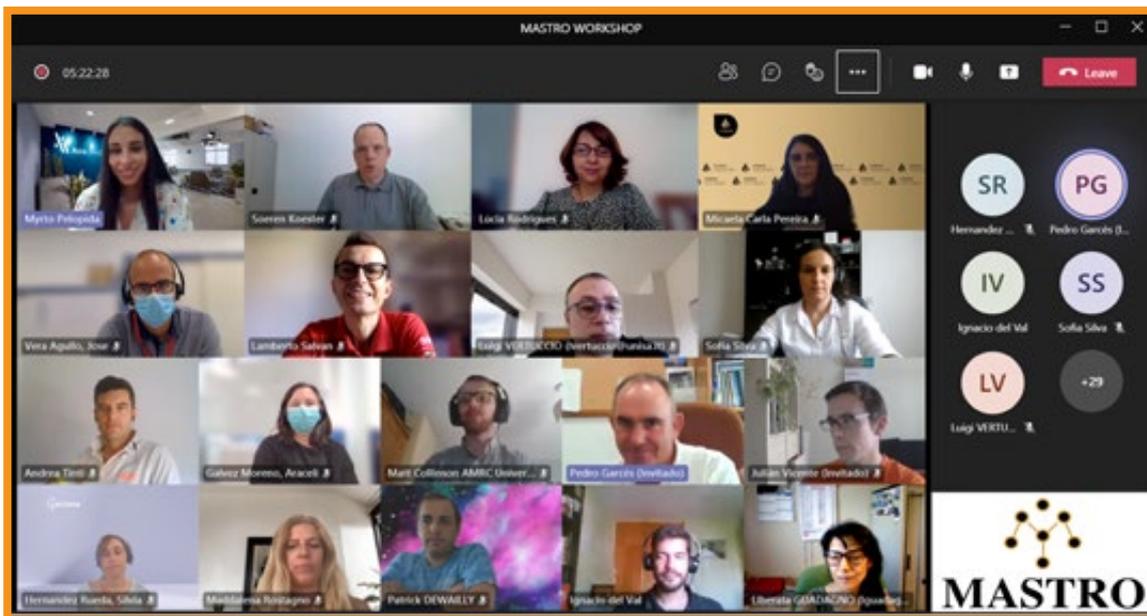

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1. The MASTRO Workshop on “Developing Intelligent bulk Materials for Smart Transport Industries”

On the 7th on July 2021, MASTRO held its final workshop about “Developing Intelligent bulk Materials for Smart Transport Industries”. The workshop was focused on how MASTRO has developed intelligent nano enabled bulk materials with self-responsive properties for the automotive, aerospace and transport infrastructure industries.



The workshop was divided into 3 sessions covering the main research activities implemented throughout the project's lifetime:

Session I: Smart materials development

In session I, the project's material experts UNSIA and CETMA presented the intelligent bulk materials design and development process covering the design of anti/de-icing bulk resins based on the joule heating (UNISA) and the development of smart thermoplastics with self-responsive functionalities for automotive and aerospace applications (CETMA).

Session II: Smart functionalities model

In session II, IPC in collaboration with UNISA presented how the self-responsive properties addressed in the project are simulated by a multi-scale predictive model which is integrated into a user-based application for predictive modelling and manufacturing optimization.

Session III: Demonstrators in the aerospace, automotive and transport infrastructure sector

In session III, our end users presented the demonstrators developed in order to validate the functionality of the intelligent bulk materials incorporated in various critical transport sector components. The MASTRO ICT Platform was presented by Pinout Solutions focusing on how to turn data into valuable insights using Industry 4.0 technologies.



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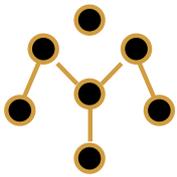
1. The MASTRO Workshop on “Developing Intelligent bulk Materials for Smart Transport Industries”

Overall, 53 registrations were recorded with around 46 actually attending the workshop, resulting into a successful dissemination event followed by a fruitful discussion. The video recording of the workshop is available on [YouTube](#) and the relevant dissemination material designed for promotional purposes can be found on the [MASTRO](#) website!



TIME	AGENDA ITEM	
09:00 - 09:15	Welcome and general introduction	AXIA
Session I: Smart Material Development		
09:15 - 09:45	Design of anti/de-icing bulk resins based on the joule heating	UNISA
09:45 - 10:15	Development of smart thermoplastics with self-responsive functionalities for automotive and aerospace applications	CETMA
Session II: Smart functionalities model		
10:15 - 10:45	Smart functionalities model	IPC
10:45 - 11:00	Coffee Break	
Session III: Demonstrators of the aerospace, automotive and transport infrastructure sectors		
11:00 - 11:50	High performance smart composites for use in Aerospace and Automotive applications	AMRC, Sheffield University
11:50 - 12:10	Self-heating smart components for automotive exterior applications	ALKE
12:10 - 12:30	Self-heating textile for automotive interior	CITEVE
12:30 - 13:00	Lunch	
13:00 - 13:20	Development of smart concrete with self-strain sensing functionalities for civil engineering and architecture applications	University of Alicante
13:20 - 13:40	Design of Smart Asphalt pavements	ACCIONA
13:40 - 14:00	The MASTRO ICT Platform: turning data into valuable insights using Industry 4.0 technologies	Pinout Solutions
14:00 - 14:30	Closing discussion	AXIA, All



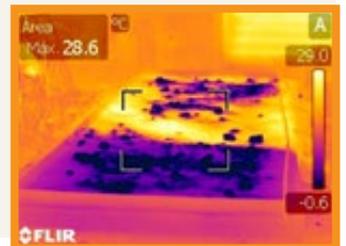


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2. THE FINAL RESULTS OF MASTRO

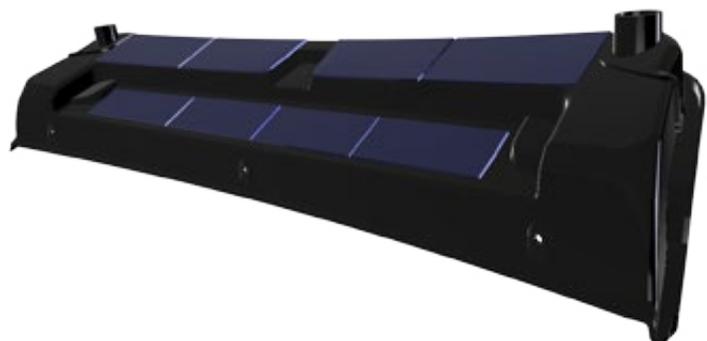
ACCIONA

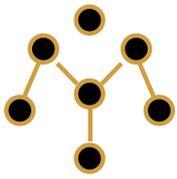
MASTRO Self-deicing pavements represent an interesting alternative to other existing pavement heating technologies, since they combine the advantages of bulk conductive materials with a simplified electrodes placement process that improves energy efficiency.



ALKE

ALKE's demonstrator AU3- Windshield Cowl Cover. This is the tested and final configuration with proper power supply and sensor system connected.



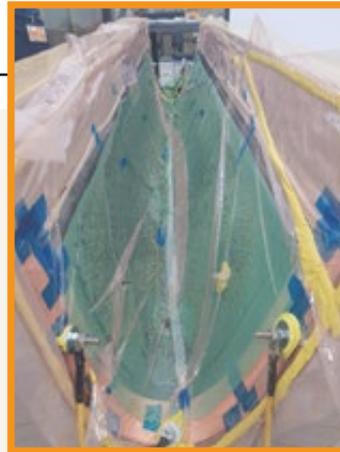


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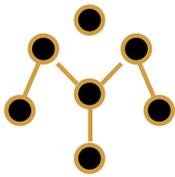
2. THE FINAL RESULTS OF MASTRO

AMRC - University of Sheffield

The leading-edge demonstrators (AE1 and AE2) were manufactured using two composite manufacturing techniques: vacuum-assisted resin infusion and pre-impregnated fibre lamination. The two demonstrators included smart functionalities such as embedded self-sensing, embedded anti-icing and self-curing. For the remainder of the project these smart function will be tested to evaluate their capabilities.



As part of the validation of the anti-icing smart functionality, The University of Sheffield and AMRC conducted anti-icing trials at the LVV. These trials consisted of building up a layer of ice on the leading-edge demonstrators to simulate ice formation in real-world conditions. The leading-edge demonstrators anti-icing capability consists of embedded continuous carbon fibres in conjunction with carbon nanotubes (CNTs) to improve conductivity. The trials successfully demonstrated the anti-icing capability as ice was removed from the surface.

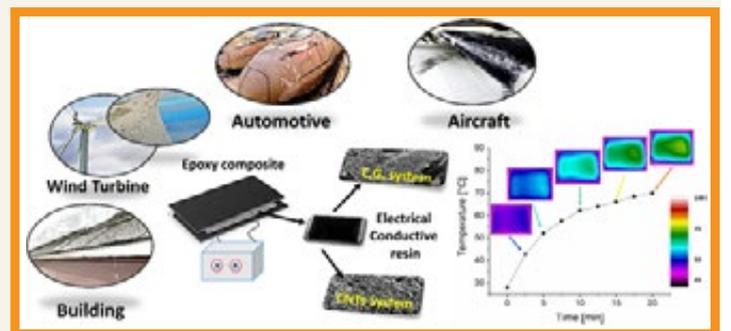
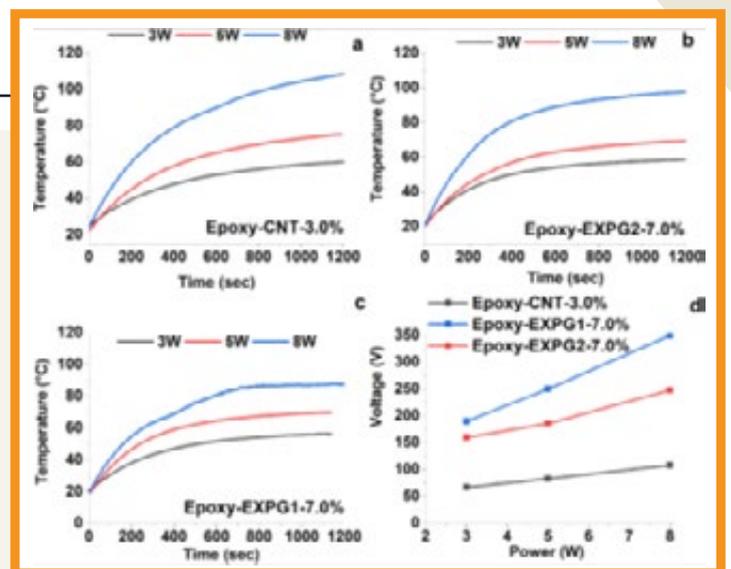


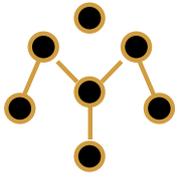
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UNISA - Applynano Solutions

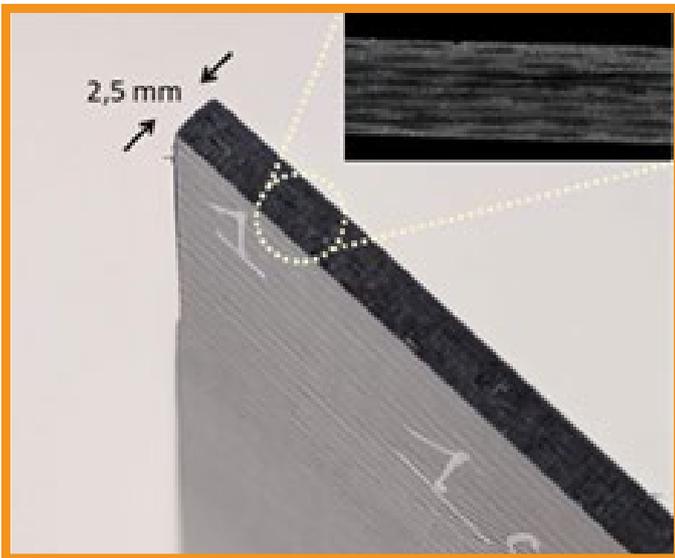
During the activities of "Mastro Project" bulk nanomaterials able to provide ice protection for different applications ranging from civil/aeronautical/aerospace to automotive engineering have been designed. Bulk nanomaterials containing dispersed electrically conductive nanoparticles have been formulated. The heating performed through the Joule effect represents an efficient strategy to rapidly contrast extreme cold and humidity conditions, to reduce environmental pollution and to control rheological properties during the process. The effectiveness of the Joule effect has been evaluated for the same resin, characterized by low values of viscosity, containing incorporated carbon nanotubes and two different grades of expanded graphite. The comparison among the chosen fillers highlights that the nanocomposite containing incorporated the unidimensional filler reaches higher temperatures for lower values of the applied voltage. Graphite nanoplatelets can be advantageously used to reduce the viscosity of the nanomaterials. A higher expansion of the graphite improves the heating efficiency.





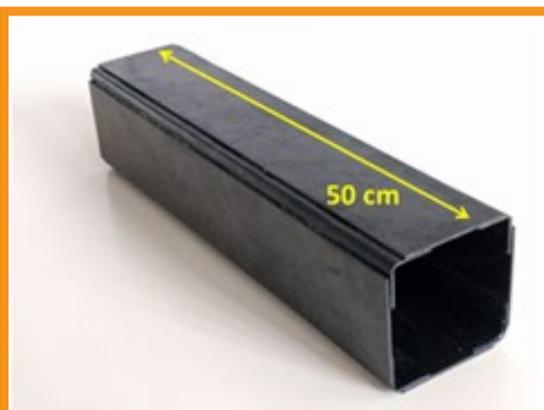
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2. THE FINAL RESULTS OF MASTRO



CETMA

The AE3 demonstrator is a representative section of an aircraft fuel system component, in particular a fuel pipe, with self-protection functionality from electrostatic discharge (ESD). The AE3 demonstrator is a continuous carbon fiber reinforced composite, being the matrix material thermoplastics PPS loaded with CNTs. A multi-step procedure has been proposed and demonstrated as a possible solution for manufacturing hollow shapes, since compression moulding and induction welding are of great interest in thermoplastic composites manufacturing for aeronautics.



Anti-static protection KPI



Electrical, physical and mechanical testing were accomplished to draw up a technical datasheet of the material/component

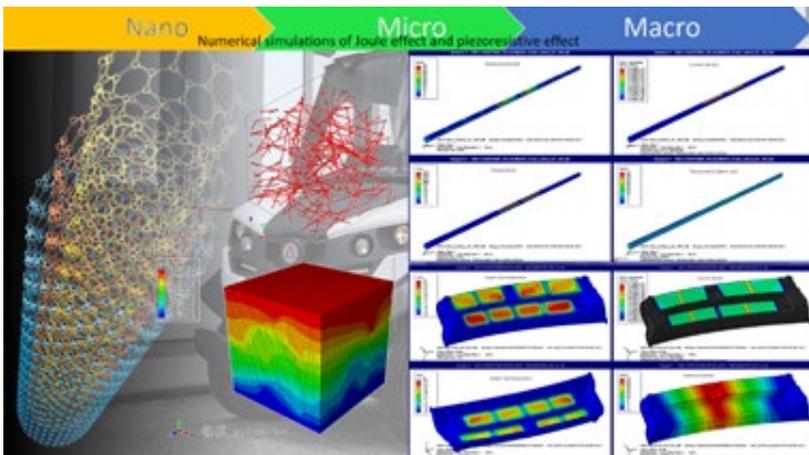


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2. THE FINAL RESULTS OF MASTRO

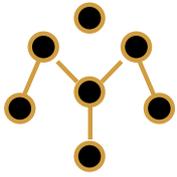
Pinout Solution

The MASTRO ICT Platform makes it possible to turn MASTRO data into valuable insights using the hottest Industry 4.0 technologies, such as IoT, Edge Computing and Serverless Computing. It fosters synergies between use cases with different degrees of maturity, enriching the research process with a set of IT best practices. The MASTRO ICT Platform is prepared for an easy scale up. It can be connected with Artificial Intelligence and Machine Learning services, allowing end users to apply advanced techniques such as Predictive Maintenance.



IPC

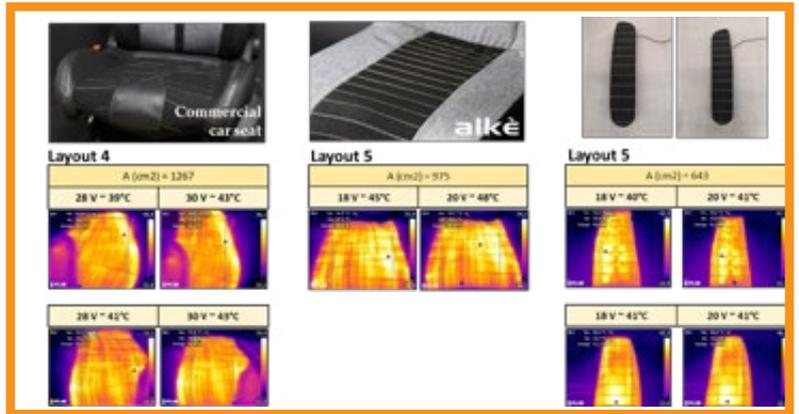
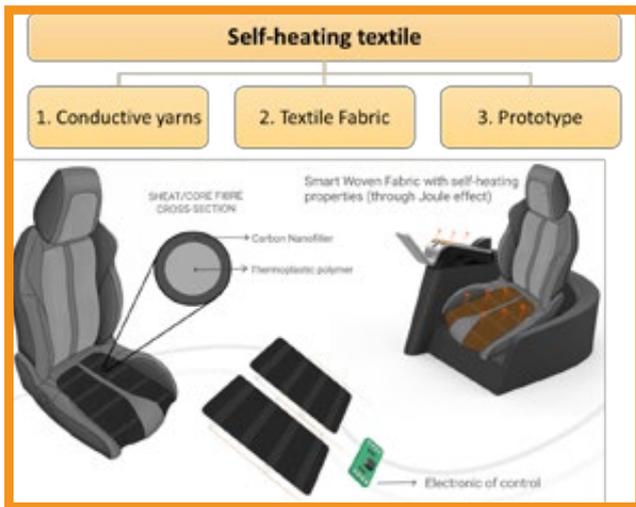
IPC executed the work of numerical simulations realized on the final MASTRO demonstrators for the Joule effect.



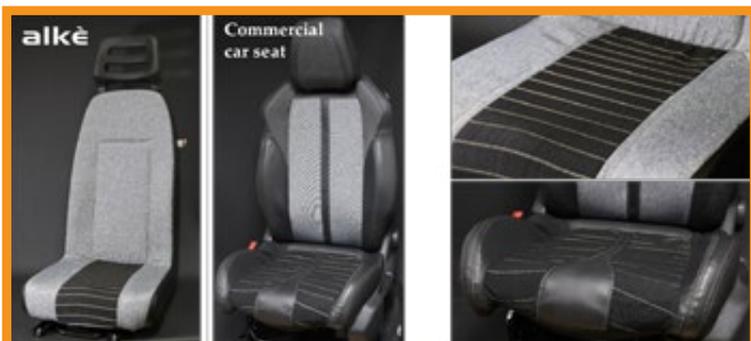
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2. THE FINAL RESULTS OF MASTRO

CENTI-CITEVE



A self-heating woven fabric based in polymeric multicomponent fibres, used as heating elements for heating comfort performance in car seats and other components, was developed and produced at pilot-scale. Electrical and thermal characterization has shown that temperatures of 35-40°C can be reached in less than 1min, for a voltage of 18V.

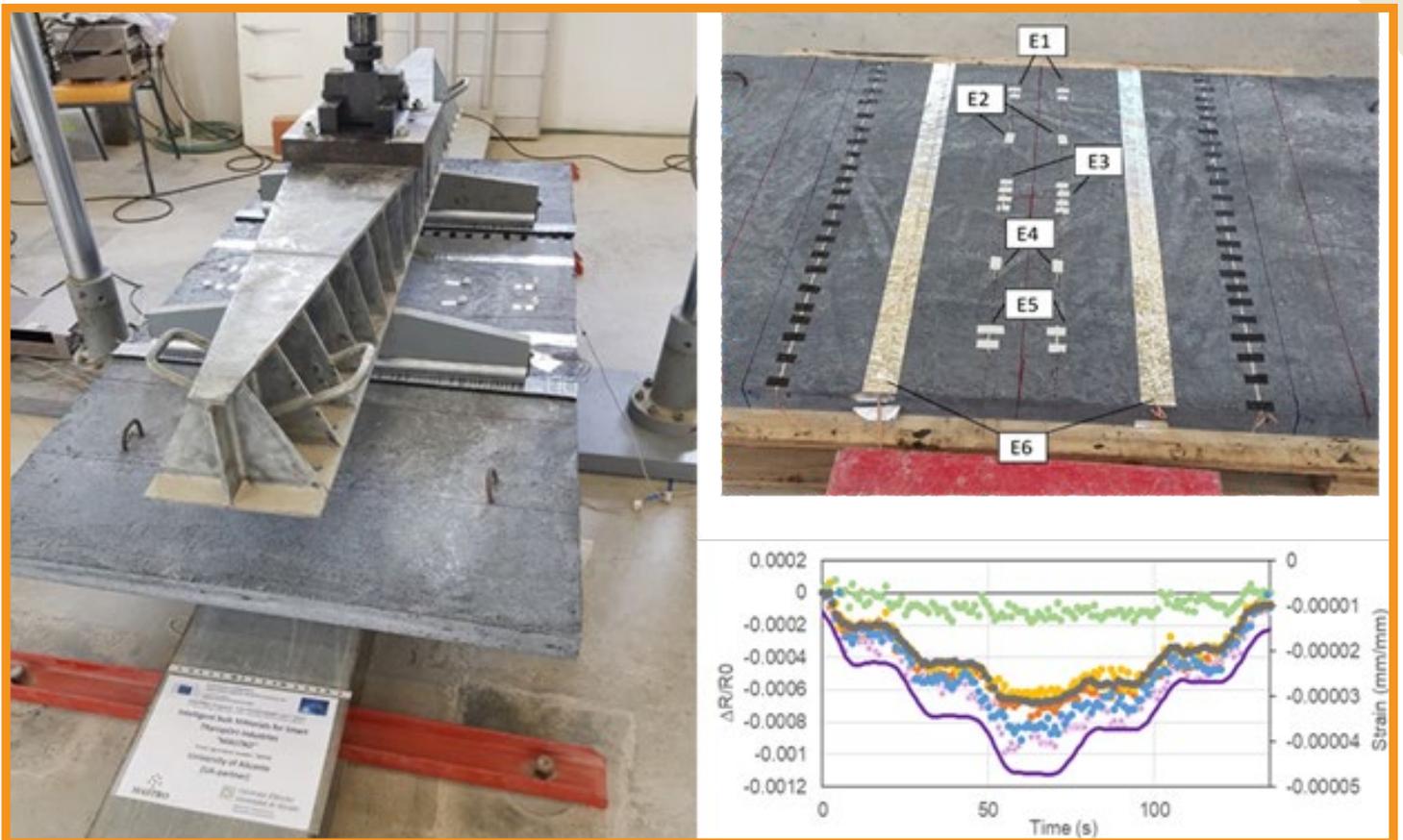




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2. THE FINAL RESULTS OF MASTRO

University of Alicante



T11-a Self-sensing concrete pavement

Smart self-sensing concrete pavements to confer the ability to monitor/store data about its own condition in terms of vibrations, defects, fatigue and strain thanks to the piezoresistivity effect were successfully developed. This development will allow to monitor concrete pavements and beam prototypes to be implemented in roads and bridges and Structural Health Monitoring for safety reasons.



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3. MASTRO EXPLOITATION PLAN

Special focus has been given on the exploitation plan of the MASTRO project highlighting the innovative transport components solutions developed within the project which represent an improvement in respect to today's available commercial solutions.

The exploitation strategy builds on three pillars: (a) the detailed analysis of the key exploitable results (KERs), (b) an effective dissemination strategy, and (c) the development of business plans tailor-made to the needs and objectives of each industrial partner.

MASTRO EXPLOITATION PLAN



Key exploitable results

A thorough analysis of the key exploitable results identified during the project's lifetime has been conducted including a categorization of the KERs into groups according to the type of product developed, the definition of final ownerships and the selection of the appropriate intellectual property measures for each partner.

Complementary to this analysis, the external environment in which the key exploitable results will be presented has been assessed by conducting a PESTLE & SWOT Analysis, a market analysis, while the patent landscape has been examined using the innovation intelligence platform Patsnap.



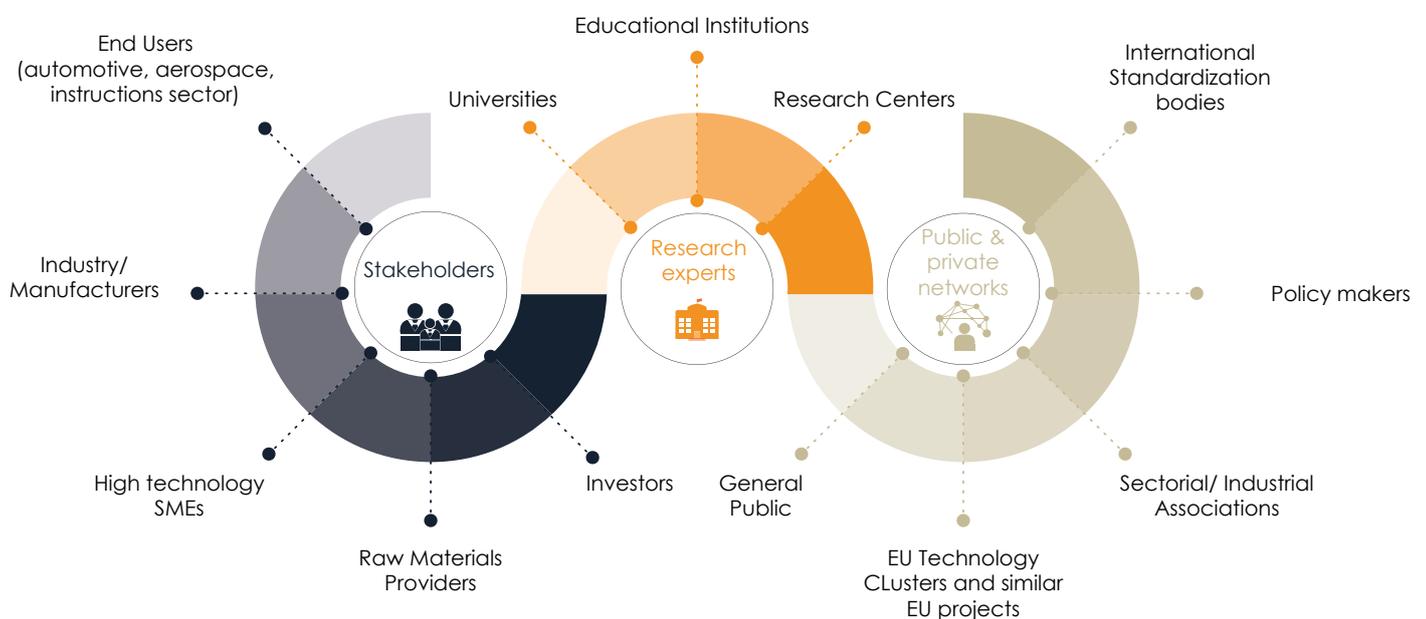
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3. MASTRO EXPLOITATION PLAN

Dissemination strategy

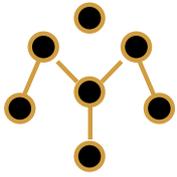
Key part of any exploitation plan is an effective dissemination strategy serving as the guide towards the promotion and market adoption of the MASTRO key technologies. This required the definition of:

- ♦ the subject of dissemination (what will be disseminated),
- ♦ the target audience (who will be interested and benefit from the project results),
- ♦ methods and tools (what is the most effective way to reach the target audience),
- ♦ the timing (when dissemination will take place),
- ♦ the dissemination management and policy (who is responsible for and how dissemination is managed).



Individual Business Plans

In order to conclude the exploitation plan of the project, individual business plans tailor-made to needs and expectations of the industrial partners have been designed. This includes the formulation of the value propositions, the design of CANVAS business models, the definition of the external and internal environments (PESTLE- SWOT Analysis), the identification of relevant risks and mitigations plans as well as the appropriate marketing activities and financial projections.



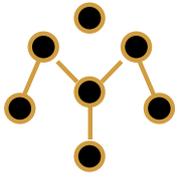
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4. MASTRO DISSEMINATION ACTIVITIES



1. MASTRO participated in the EuroNanoForum 2021 on the 5-6 May 2021. Our coordinator, ACCIONA, presented the technical poster at the virtual both of the MASTRO project open for questions and fruitful discussions about the research findings of MASTRO.

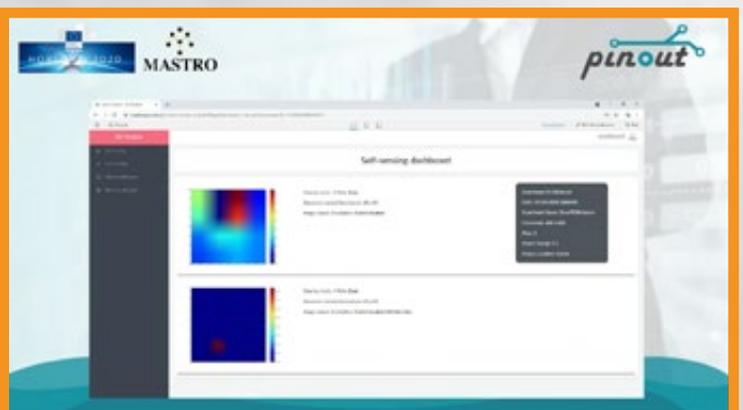


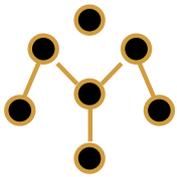


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4. MASTRO DISSEMINATION ACTIVITIES

2. On the 13th of May 2021 our partner Pinout Solutions held a webinar to Start-ups & SMEs that belong to the Madrid Council Entrepreneurship Network. Pinout Solutions presented the MASTRO project focusing on the ICT Platform and on how Industry 4.0 technologies can contribute on cutting-edge R&D Projects, dealing with complex data from different sources and turning it into valuable, useful and attractive information for value generation.





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4. MASTRO DISSEMINATION ACTIVITIES



3. Our partner AMRC published an interesting interview on their work and advances regarding the development of smart materials with self-curing, self-anti-icing and self-sensing properties for aerospace composites. Read how this will contribute towards the reduction of greenhouse gas emissions and production costs in the aviation sector as it works toward the goal of net zero by 2050.

Check out the article under:

<https://www.amrc.co.uk/news/nanoscale-materials-hold-cure-for-manufacturing-and-aviation-greenhouse-gas-emission>

4. AXIA Innovation attended the EU Brokerage Event on Key Enabling Technologies 2021 discussing the Key Enabling Technologies as they are prioritised by the EU, focusing on advanced manufacturing and advanced materials.





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5. MASTRO Publications 2021

1. Marialuigia Raimondo, Elisa Calabrese, Wolfgang H. Binder, Philipp Michael Sravendra Rana and Liberata Guadagno. "Tunneling Atomic Force Microscopy Analysis of Supramolecular Self-Responsive Nanocomposites". *Polymers* 2021, 13(9), 1401; (<https://doi.org/10.3390/polym13091401>)
2. Liberata Guadagno, Patrizia Lamberti, Vincenzo Tucci and Luigi Vertuccio. "Self-Sensing Nanocomposites for Structural Applications: Choice Criteria". *Nanomaterials* 2021, 11(4), 833; (<https://doi.org/10.3390/nano11040833>)
3. Marialuigia Raimondo, Carlo Naddeo and Liberata Guadagno. "Effect of non-covalent functionalization of graphene-based nanoparticles on the local electrical properties of epoxy nanocomposites ". *IOP Conference Series: Materials Science and Engineering* 1024 012004; (<https://iopscience.iop.org/article/10.1088/1757-899X/1024/1/012004>)
4. Beatriz del Moral, F. Javier Baeza, Rosa Navarro, Oscar Galao, Emilio Zornoza, Jose Vera, Catalina Farcas, Pedro Garcés. "Temperature and humidity influence on the strain sensing performance of hybrid carbon nanotubes and graphite cement composites". *Construction and Building Materials* Volume 284, 17 May 2021, 122786; (<https://doi.org/10.1016/j.conbuildmat.2021.122786>)
5. C Farcas, O Galao, R Navarro, E Zornoza, F J Baeza, B Del Moral, R Pla, and P Garcés. "Heating and de-icing function in conductive concrete and cement paste with the hybrid addition of carbon nanotubes and graphite products". *Smart Materials and Structures*. 30 (2021) 045010 (12pp); (<https://doi.org/10.1088/1361-665X/abe032>)
6. L.Vertuccio; F. Foglia; R. Pantani; M. D. Romero-Sánchez; B. Calderón; L. Guadagno. "Carbon nanotubes and expanded graphite based bulk nanocomposites for de-icing applications". *Composites Part B: Engineering* Volume 207; 15 February 2021, 108583; (<https://doi.org/10.1016/j.compositesb.2020.108583>)



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6. MASTRO Videos

AXIA Innovation, who is responsible for the dissemination and communication strategy of the project has created several videos for promoting the project's research efforts and results.

MASTRO Teaser

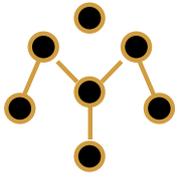
A video teaser has been released on [Youtube](#) with the purpose to entice the wider public to anticipate the upcoming videos.



MASTRO Infographic Video

The official MASTRO conceptual video has been serving as a powerful, effective part of the MASTRO marketing strategy and boosts the awareness, interest, and interaction of all the different stakeholder groups within MASTRO.

The video can be found on [Youtube](#) and the official [website](#) of MASTRO.



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6. MASTRO Videos



Video presenting the dissemination material

Furthermore, a video presenting all the dissemination material produced throughout the project has been created supplementarily to the deliverable D9.5 Presentation of Dissemination Material. The video is available on [Youtube](#).

Final Video

The final video of MASTRO focuses on the highlights of the project by presenting the main research outcomes generated by each partner among with the impact that the whole project has created through the intensive research activities and the cross-functional collaboration between the consortium. The video is available on [Youtube](#) and the official website of MASTRO.





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7. Who we are...

MASTRO consortium is a multidisciplinary mix of engineers, materials experts, and high tech companies, from 6 European countries

For more details visit: www.mastro-h2020.eu/partners



Visit our website and subscribe to our newsletter
www.mastro-h2020.eu



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