MADECOLD

NEWS LETTER

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Coordinator’s Note

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I am delighted to introduce this MADECOLD Newsletter, where we share the latest news, milestones, and highlights from the MADECOLD project. Funded by the European Union, MADECOLD brings together researchers and institutions from across Europe with a shared goal: developing an innovative solid-state additive manufacturing approach based on particle charging, acceleration, and precise control.

In this issue, you’ll find updates from the consortium, including the welcome of new partners and team members, insights from recent technical visits and meetings, and highlights from conferences and scientific publications. We also take a closer look at the technologies and experimental platforms supporting our work, as well as the collaborative efforts that are helping turn research concepts into practical applications.

This newsletter is designed to keep you connected with our progress and the people behind it. We hope it gives you a clear and enjoyable snapshot of where MADECOLD is today and where we are heading next.

Thank you for joining us on this journey. I look forward to sharing many more updates with you in the issues to come.

MADECOLD: A Breakthrough in Solid-State Additive Manufacturing

MADECOLD is set to transform metal additive manufacturing through a novel solid-state process that overcomes the limitations of today’s thermal and cold spray technologies. By combining powder acceleration with electrostatic charging, the project enables high-precision, high-rate deposition of multi-material structures across surfaces of virtually unlimited size. This breakthrough opens the door to more sustainable, scalable, and flexible manufacturing — including gravity-independent production and repair of future space structures.

Consortium Updates

From 5th May 2025, **Center for Physical Sciences and Technology (FTMC)** (Lithuania) joined the MADECOLD Consortium as a new project partner. The collaboration has been established through the Hop-On call HORIZON-WIDERA-2023-ACCESS-06.
FTMC was selected for its advanced expertise in the design and manufacturing of micrometric channels, capable of meeting the stringent geometrical tolerances required for the MADECOLD launcher. This capability represents a key contribution to the completion and advancement of the consortium’s technical objectives.
The MADECOLD team warmly welcomes FTMC and looks forward to a productive collaboration.

MADECOLD University Partners

1. Politecnico di Milano (Polimi), Italy – Project Coordinator
2. University of Stuttgart, Germany
3. University College Dublin (UCD), Ireland
4. Trinity College Dublin (TCD), Ireland
5. Center for Physical Sciences and Technology (FTMC) (Lithuania)

CONTACT US

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MADECOLD Consortium Visits University of Stuttgart to Explore LINAC Technology

On 2 December 2025, MADECOLD consortium members visited the University of Stuttgart to gain hands-on insight into the operation of their linear accelerator (LINAC) system and dust accelerator facilities. The visit offered a unique opportunity to explore cutting-edge technology that supports research in Metal Additive Manufacturing using cold spray.

The day began with an introduction by Prof. Ralf Srama, who presented the Institute for Space Systems (IRS) and the Cosmic Dust Group, followed by Prof. Mario Guagliano, who outlined relevant tasks in Work Package 3 (WP3). The technical program included detailed demonstrations of the dust source breadboard and LINAC operation by Dr. Yanwei Li and Mr. Marcel Bauer, as well as a guided tour of the 2 MV dust accelerator facility.

Participants also observed the first substrate examinations with deposition processes, led by Dr. Amir Ardeshiri Lordejani and remotely by Dr. Pengfei Yu, and discussed upgrades to the LINAC and dust source. A session on the electromagnetic gate control unit was conducted by Dr. Allen Mathew, Dr. Rahul Antony, and Dr. Nan Zhang, followed by a collaborative discussion on upcoming project tasks.

The visit provided consortium members with practical insights into accelerator operations, strengthened technical understanding for MADECOLD objectives, and fostered collaboration between partners. The consortium expressed gratitude to the University of Stuttgart team for their hospitality and looks forward to further joint work in 2026.

MADECOLD Research Presented at Transcom 2025 Conference

Monil Mihirbhai Thakkar, PhD student at Politecnico di Milano, presented his latest research at the Transcom 2025 Conference, held from 21–23, May 2025 in the High Tatra Mountains, Slovakia. The presentation, entitled "Metal Particle Acceleration to Supersonic Speed: "Numerical Simulation and Preliminary Results", highlighted the feasibility of LINAC-based particle acceleration and bonding.

The research was conducted in collaboration with Dr. Yanwei Li (University of Stuttgart), Dr. Amir Ardeshiri Lordejani, and Prof. Mario Guagliano, and focused on analyzing particle acceleration behavior under varying charge-to-mass ratios. Key findings demonstrated that individual particles require carefully optimized charge-to-mass ratios to achieve supersonic speeds, while effective acceleration remains limited to one particle at a time, even under dynamic voltage switching. Furthermore, the study showed that although a constant charge-to-mass ratio enables uniform acceleration, a theoretical upper limit constrains its applicability across different particle types.

This work directly supports MADECOLD's core objective of enabling particle deposition through electric fields, providing numerical validation for the feasibility of using LINAC systems within the project's technological framework. The presentation also contributed to strengthening MADECOLD's visibility within the international research community.

Consortium Updates

New Member Joins MADECOLD

The MADECOLD project is pleased to welcome Dr. Adrián Vicente Gómara, who joined University College Dublin (UCD) as a postdoctoral researcher on 5 January 2026. His research will focus on developing an electromechanical gate and substrate control for the project's multi-material printing system, thereby strengthening MADECOLD's technical capabilities.

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What MADECOLD Logo Represents?

Funded by the European Union's Horizon Europe research and innovation programme under grant No. 101130639.

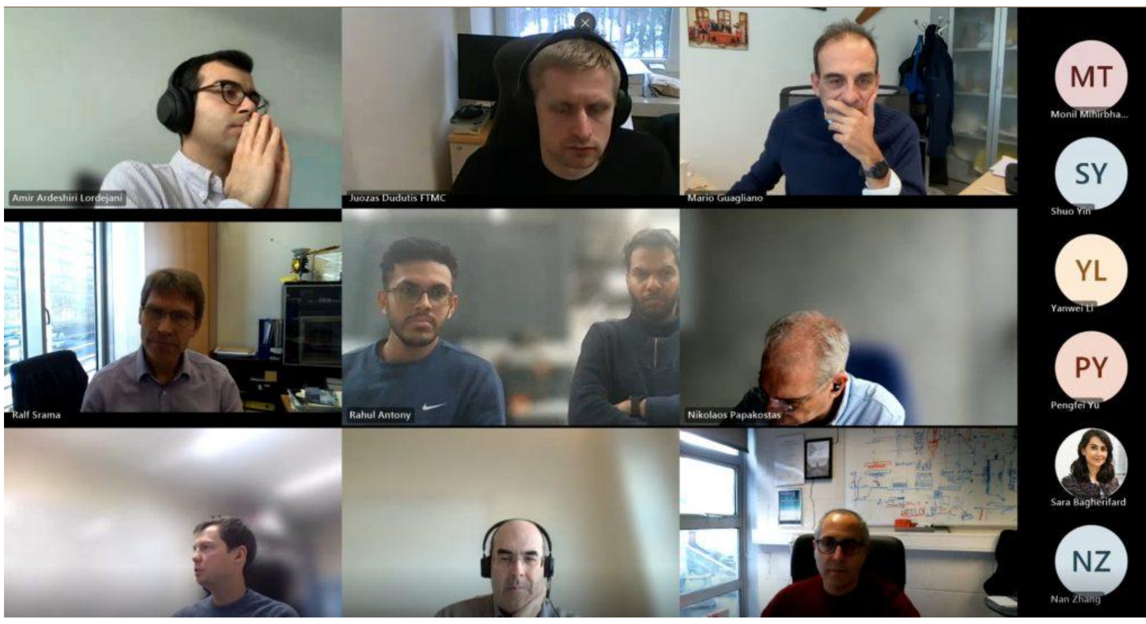

Image: Screenshot taken from the MADECOLD online board and management meeting

MADECOLD Board and Management Meeting

On 4 February 2025, the MADECOLD consortium held its six-month (M6) Board and Management Meeting online. Researchers from Politecnico di Milano, University College Dublin, Trinity College Dublin, and the University of Stuttgart collaborated to review project progress and align on the next phase of this EU-funded initiative, focusing on electric - field - assisted solid - state deposition for multi-material printing.

The meeting opened with remarks from Project Coordinator Prof. Mario Guagliano, followed by detailed updates from each work package.

The consortium reported strong progress across technical activities, with key deliverables remaining on track. Dr. Paulius Gečys from FTMC, a prospective Hop-On partner at the time, presented their proposed concept for micro-channel milling, highlighting its relevance to MADECOLD's technological objectives.

Administrative discussions covered EU reporting timelines, committee roles and chair confirmations, selection of a preferred data-sharing platform, and a review of project quality assurance procedures.

Publications Section

New MADECOLD Publication on Linear Accelerator Technology

The MADECOLD consortium is pleased to announce a new scientific publication by project partners at the University of Stuttgart, published in Applied Sciences (MDPI).

The paper, entitled "A Small Linear Accelerator for Charged Microparticles," presents the design and development of a six-stage, 120 kV linear accelerator (LINAC) capable of accelerating micron-sized charged particles to velocities of up to 1300 m/s. The system features autonomous selection of acceleration stages, allowing particles to reach predefined target speeds with high precision.

This research represents a significant contribution to MADECOLD's overarching objective of developing a novel solid-state additive manufacturing technique based on particle charging and acceleration within a controlled electrostatic field. By enabling precise control of individual particles, the proposed LINAC system supports the fabrication of multi-material structures with enhanced precision, increased build rates, and advanced surface processing capabilities.

The consortium congratulates the University of Stuttgart MADECOLD team on this outstanding achievement, which strengthens both the project's technical foundation and its impact within the wider research community.

New Experimental Capability at Trinity College Dublin Supports Advanced Particle-Based Manufacturing

Researchers from the School of Engineering at Trinity College Dublin (TCD) have developed a unique experimental platform that enables direct observation of micron-scale particle impacts at extremely high velocities. The system—known as the Laser Ablation Particle Acceleration and Observation (LAPAO) machine - is the only facility of its kind in Europe and represents more than two years of design and development by Trinity's Science & Technology in Advanced Manufacturing (STAM) research group.

LAPAO enables engineers to visualise, in real-time, how tiny particles interact with surfaces at supersonic speeds, providing critical insight into material bonding mechanisms. This capability is particularly valuable for improving advanced coating technologies used in sectors such as aerospace, biomedical engineering, and industrial machinery. While the platform has broad applications, LAPAO was developed with a specific focus on advancing the Cold Spray (CS) additive manufacturing process—a solid-state technique that enables the creation and repair of metal components without melting the material. One of the major challenges in Cold Spray manufacturing is its high cost, which is driven by process inefficiencies. Addressing these inefficiencies requires a deeper understanding of particle–substrate interactions at high velocities.

Leo Devlin, PhD candidate in Trinity's School of Engineering and a key member of the STAM team, explained: "With this machine we can visualise real material interactions for a wide range of particle and substrate materials in minutes, which will aid us in understanding and optimising the Cold Spray process for specific materials."

To date, LAPAO has been used to identify critical impact velocities for materials such as aluminium, Ti-6Al-4V (Ti64), and high-entropy alloys - materials commonly used as functional coatings in the electrical and automotive industries to achieve lightweight components with improved wear and corrosion resistance. The research has been led by the STAM team at Trinity College Dublin, including Prof. Rocco Lupoi and Prof. Shuo Yin, and contributes directly to the scientific foundations underpinning MADECOLD's work on particle-based solid-state manufacturing and multi-material printing.

People behind the Project MADECOLD

Project Roadmap at a Glance

The project is structured into **five interconnected phases** aimed at developing and validating an advanced electrostatic powder acceleration–based manufacturing system.

Phase 1 establishes the scientific foundation by developing theoretical and numerical models to understand metallic particle acceleration, impact behavior, and bonding mechanisms.

Phase 2 focuses on the design and optimization of the particle launcher and powder feeding system, including charging, acceleration, and beam control to ensure stable and efficient particle deposition.

Phase 3 advances the system with the development of **micro-electromechanical gates**, enabling continuous and precisely modulated particle feeding. Multiphysics simulations are used to optimize performance and reliability, forming a digital twin of the system.

Phase 4 integrates all components into a controlled multi-channel feeder and launcher. The system is validated through precise trajectory control, real-time adjustment, and automated positioning for accurate material deposition.

Phase 5 demonstrates full **3D printing capability** and evaluates manufacturing applications across key sectors. Validation includes multi-material printing, mechanical testing, energy efficiency assessment, and cost comparison with existing additive manufacturing methods.

The technology will be demonstrated in **aerospace, energy, and hybrid manufacturing**, showcasing its potential for lightweight, high-performance, and precision-engineered components.

Know more about the team

People

MADECOLD Newsletter

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