



PROGRAM

Berlin | March 15 – 16, 2023



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WELCOME TO DDMC 2023



Dr. Bernhard Mueller
Fraunhofer DDMC Conference Chairman
Spokesperson Fraunhofer Competence
Field Additive Manufacturing

Welcome to the 6th Fraunhofer Direct Digital Manufacturing Conference DDMC 2023 in Berlin! This biennial conference on Additive Manufacturing (AM) and 3D Printing (3DP) is organized by the **Fraunhofer Competence Field Additive Manufacturing**, which integrates eighteen Fraunhofer institutes across Germany that are involved with applied R&D in the field of AM & 3DP.

Well-known national and international speakers present the latest developments in AM, focusing on the topics of Product Development, Technologies, Materials, Quality, Post Processing and Software. The conference program has been broken up into **19 conference sessions with a total of 52 oral presentations and a dedicated poster session**. We also continue to present latest trends not only from science and research, but also from the AM industry. These presentations are highlighted in the program as **Industrial Contributions** and are not accompanied by a full paper in the conference proceedings.

We gladly announce our four prominent **keynote-speakers**: **Aditya Chandavarkar** (AMTech, Mumbai, India), **Barbara Imhof** (LIQUIFER Systems Group, Vienna, Austria), **Mihaela Vlasea** (University of Waterloo, Canada) and **Özlem Weiss** (Expertants, Frankfurt, Germany). Be excited about their international point of view in different fields of Additive Manufacturing and its application.

Extended coffee breaks shall invite you to visit the booths of our four exhibitors: **HEXAGON, Rosswag Engineering, Sentex-BIR and NANOVAL** – take the chance to get in touch with these companies!

The Fraunhofer DDMC **conference dinner** on Wednesday evening will be held in the historical cellar of the **Weihenstephaner**, in walking distance from the conference hotel. Benefit from the great opportunity to make new contacts or to meet established colleagues in this historical location! This evening promises excitement for all, who are involved with Additive Manufacturing in their professional life! We thank our exclusive Gold Sponsor **NANOVAL GmbH & Co. KG** from Berlin to support our conference dinner!



The traditional **DDMC Best Paper & Best Poster Award**, which honor the best paper and best poster presented at Fraunhofer DDMC 2023, will be awarded on the second conference day. This year, we will also award the best oral presentation held at the conference with the **Best Presentation Award**.

Finally, a special edition of the renowned **Springer Nature journal “Progress in Additive Manufacturing” (PIAM)** accompanies this year’s DDMC once again, containing the nine best papers submitted to Fraunhofer DDMC 2023. We are happy and delighted to collaborate with PIAM as our scientific media partner and publishing medium for the most outstanding DDMC contributions. Our thanks go out to PIAM’s Editor-in-Chief, Eujin Pei, and the entire PIAM team at Springer! Please enjoy a complimentary printed copy of the DDMC 2023 special issue of PIAM, which you can find in your conference folder, handed out to you during registration!

We also thank our industrial media partners **x-Technik IT & Medien GmbH** and **Inovar Communications**. Please enjoy reading the current issues of **“Additive Fertigung”**, **“Metal AM Magazine”** or **“PIM International”**, which you can also find in your conference folder. We express our thanks to DDMC’s Silver Sponsors **EOS, HEXAGON, pro-beam** and **Siemens** for their support of the conference!

Finally, I express my gratitude to DDMC’s **Scientific Committee** for supporting the conference, by reviewing so many submitted papers and helping us to maintain the high scientific and technological standard of Fraunhofer DDMC!

You are cordially invited to meet the additive manufacturing community in the vibrant heart of **Berlin!** I am convinced that all conference participants will learn more about the latest trends in additive manufacturing and will benefit from new ideas and contacts. Please enjoy Fraunhofer DDMC 2023!

Dr. Bernhard Mueller

Fraunhofer DDMC Conference Chairman

Spokesperson of the Fraunhofer Competence Field Additive Manufacturing

PROGRAM OVERVIEW

		DOEBLIN I	DOEBLIN II	EHRlich / ZILLE STUBE*
Wednesday, March 15, 2023	8.30 am – 9.15 am	Check-in		
	9.15 am – 10.30 am	Opening & Plenary Keynotes		
	10.30 am – 11.15 am	Coffee Break		
	11.15 am – 12.30 pm	1.1 Powders	1.2 Materials (Metals)	1.3 Materials (Polymers and composites)*
	12.30 pm – 2.00 pm	Lunch Break		
	2.00 pm – 3.15 pm	2.1 Metal Technologies – L-PBF I	2.2 Extrusion Technologies	2.3 Multimaterial Technologies*
	3.15 pm – 4.00 pm	Poster Session & Coffee Break		
	4.00 pm – 5.15 pm	3.1 Metal Technologies – L-PBF II	3.2 Functionalization in AM	3.3 Industrialization and Circular Economy
	7.00 pm – 10.30 pm	Conference Dinner		
Thursday, March 16, 2023	9.00 am – 10.15 am	Plenary Keynotes II		
	10.15 am – 11.00 am	Coffee Break		
	11.00 am – 12.15 pm	4.1 Industrialization and Smart Production	4.2 Quality	4.3 Production Use Cases
	12.15 am – 1.45 pm	Lunch Break		
	1.45 pm – 3.00 pm	5.1 Simulation	5.2 Digital Production	5.3 Developments in Hardware
	3.00 pm – 3.30 pm	Coffee Break		
	3.30 pm – 4.20 pm	6.1 Printed Electronics I	6.2 Software Platforms	6.3 Printed Electronics II
	4.20 pm – 4.45 pm	Closing & Best Paper, Best Poster and Best Presentation Award		

GENERAL INFORMATION

CONFERENCE REGISTRATION

The conference registration fee includes admission to all conference sessions and the poster session. The conference package includes an electronic copy of the proceedings, a printed version of the “DDMC 2023 Special Issue” of Springer’s PIAM Journal (Progress in Additive Manufacturing), a list of registered conference participants and authors, lunch and refreshments during breaks. Regular participants have free admission to the conference dinner. For students and accompanying persons extra tickets can be purchased for this event.

THE REGISTRATION DESK IS OPEN

Wednesday, March 15, 2023 08.30 am – 06.00 pm

Thursday, March 16, 2023 08.30 am – 05.00 pm

DOOR REGISTRATION FEE

Regular 940 EUR

LUNCH AND COFFEE BREAKS

Coffee breaks will be taking place outside the main conference room. Lunch will be served in the Restaurant Humboldt’s next to Zille Stube on the second floor on both days.

DIETARY REQUIREMENTS

The rich buffet lunch is designed to cater for all dietary requirements and all tastes. When in doubt, please consult one of the chefs serving the food, they will be able to give you detailed information.

INTERNET ACCESS

Park Inn by Radisson kindly provides free Internet access for all conference participants. The password is available at the hospitality desk.

CONFERENCE LANGUAGE AND PROCEEDINGS

The official language of all presentations is English. The conference package will be handed out at the registration desk upon check-in.

CONTACT INFORMATION AND ASSISTANCE DURING THE CONFERENCE

Please do not hesitate to contact us if you have any questions or requests. Our counter and registration desk is located next to the entrance to the main conference room. We can assist you with any technical questions regarding your presentation, last-minute printing and generally any problems that might come up.



CONFERENCE VENUE

The DDMC 2023 will be taking place at the Park Inn by Radisson - Berlin Alexanderplatz, which combines the qualities of a first-class hotel with a new conference center in the heart of downtown Berlin.

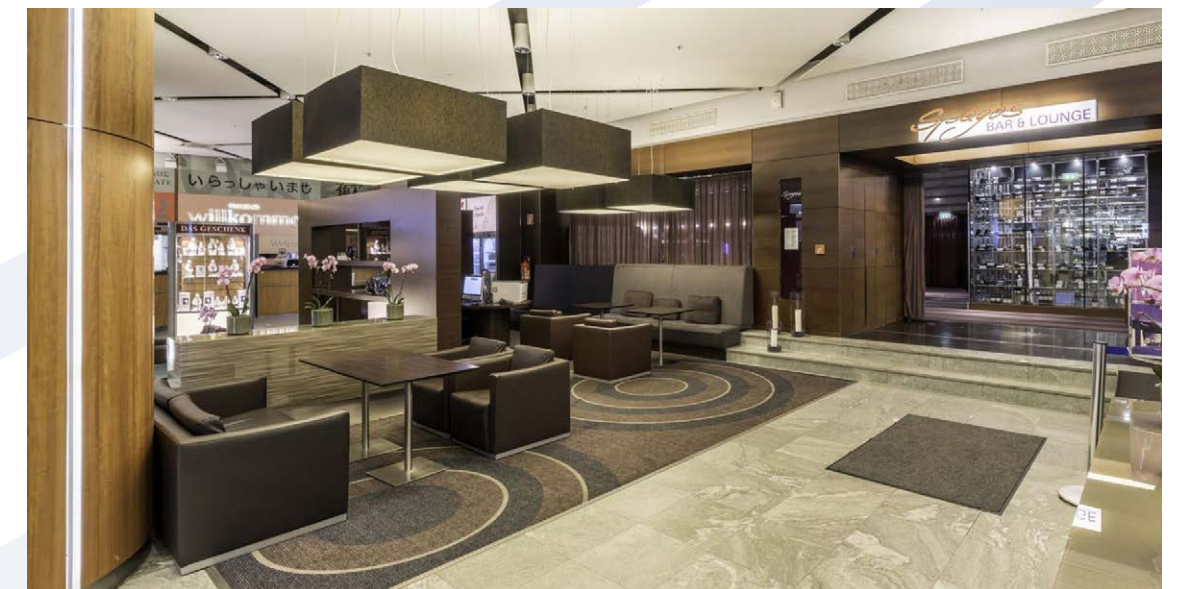
Park Inn by Radisson Berlin Alexanderplatz

Alexanderplatz 7

10178 Berlin, Germany

Phone +49 30 2389-0

The DDMC will be taking place on the 2nd and 3rd floor of the hotel. The session overview on page 8 – 9 is designed to help you find your way around. Please note that the opening, keynote and closing sessions will be taking place at Doeblin 1 and Doeblin 2 on the 3rd floor.



SPONSORS & EXHIBITORS



NANOVAL

GOLD SPONSOR AND EXHIBITOR

For 33 years, we have developed our own powder atomization process using a laval nozzle. The process has higher yields and consumes less atomizing gas. Our powders are excellent spherical and have a good flowability, since our particle distribution is very narrow. Our powders can be very small in size and very large (from MIM to EBM). We also have experience in how to atomize more than 900 different alloys - Al, Mg, platinum, Ptlr, TiAl, Ti64, Mo, Ta and W - and many more! Nanoval sells both atomizing plants and powders every day.

<https://www.nanoval.de>



EOS GMBH

SILVER SPONSOR

EOS provides responsible manufacturing solutions via industrial 3D printing technology to manufacturers around the world. Connecting high quality production efficiency with its pioneering innovation and sustainable practices, the independent company formed in 1989 will shape the future of manufacturing. Powered by its platform-driven digital value network of machines and a holistic portfolio of services, materials and processes, EOS is deeply committed to fulfilling its customers' needs and acting responsibly for our planet.

<https://www.eos.info/en>



HEXAGON | SIMUFACT ENGINEERING

SILVER SPONSOR AND EXHIBITOR

Hexagon is a global leader in digital reality solutions, combining sensor, software and autonomous technologies. We are putting data to work to boost efficiency, productivity, quality and safety across industrial, manufacturing, infrastructure, public sector, and mobility applications.

Our technologies are shaping production and people-related ecosystems to become increasingly connected and autonomous – ensuring a scalable, sustainable future.

Hexagon's Manufacturing Intelligence division provides solutions that use data from design and engineering, production and metrology to make manufacturing smarter.

hexagonmi.com

SPONSORS & EXHIBITORS

pro beam

PRO BEAM SILVER SPONSOR

The pro-beam Group is a global leader in electron beam technology and offers two additive manufacturing solutions for metal components with its subsidiary pro-beam additive GmbH.

While its EBM process (powder bed) is especially suitable for small and more detailed parts, the company also enables the additive manufacturing of larger metal parts with WEBAM (wire-based). Both processes are based on pro-beam's established electron beam technology. As a machine supplier, the company's portfolio includes corresponding machines that meet industrial needs like productivity and flexibility.

Along with additive manufacturing, the group offers solutions for electron beam welding and drilling, surface coating as well as hardening. Depending on their requirements, customers can choose between contract manufacturing or their own customized system.

<https://www.eos.info/en>

SIEMENS

SIEMENS SILVER SPONSOR

Siemens is a technology company focused on industry, infrastructure, transport, and healthcare.

As a global player in the field of additive manufacturing, Siemens is offering solutions for industrialized 3D printing for complex requirements of various industries.

Beside this, the company provides the necessary software and hardware tools for others to leverage the power of AM with Siemens' Digital Enterprise portfolio. Its holistic solutions include CAD, CAM, and CAE software for designing, validating, and optimizing parts, as well as a collaborative order-to-delivery platform for part buyers and manufacturers, known as the AM Network. Additionally, their industrial automation portfolio enables machine builders to deliver state-of-the-art 3D printers or peripheral machines, complemented by value-added services offered by experienced consultants who help to identify and optimize AM use cases, plan or scale AM factories.

www.siemens.com/additive-manufacturing

SPONSORS & EXHIBITORS



ROSSWAG ENGINEERING EXHIBITOR

The family-run company Rosswag GmbH was founded in 1911 and is a leading supplier of forged components.

Since 2014, the division Rosswag Engineering has expanded its service portfolio to include Metal Additive Manufacturing and has already produced more than 60,000 parts for end customers worldwide. The unique and holistic process chain consisting of engineering, simulation, LPBF, heat treatment, CNC machining and material analytics was extended in 2017 by the in-house metal powder production. As a result, more than 40 metal materials have now been qualified with the internal process chain for the use in LPBF processes.

In 2022, Rosswag initiated the launch of the AddiMap platform to trade process parameters and material data for Metal AM.

<https://www.rosswag-engineering.com>
www.addimap.com



SENTES-BIR EXHIBITOR

Sentes-BIR is an advanced material technology company, provides products and solutions for joining, surfacing of metals and produces metal powders for various applications for different industries.

With rapid development of additive manufacturing, Sentes-BIR develops powder for additive manufacturing and established Sentes ADDITIVE business unit as a service provider in metal additive manufacturing.

Sentes-BIR is government recognized R&D center since 2017.

In 2019, Sentes-BIR is awarded as the Most Innovative SME by KOSGEB (Small and Medium Enterprises Development Organization).

<http://www.sentes-bir.com>



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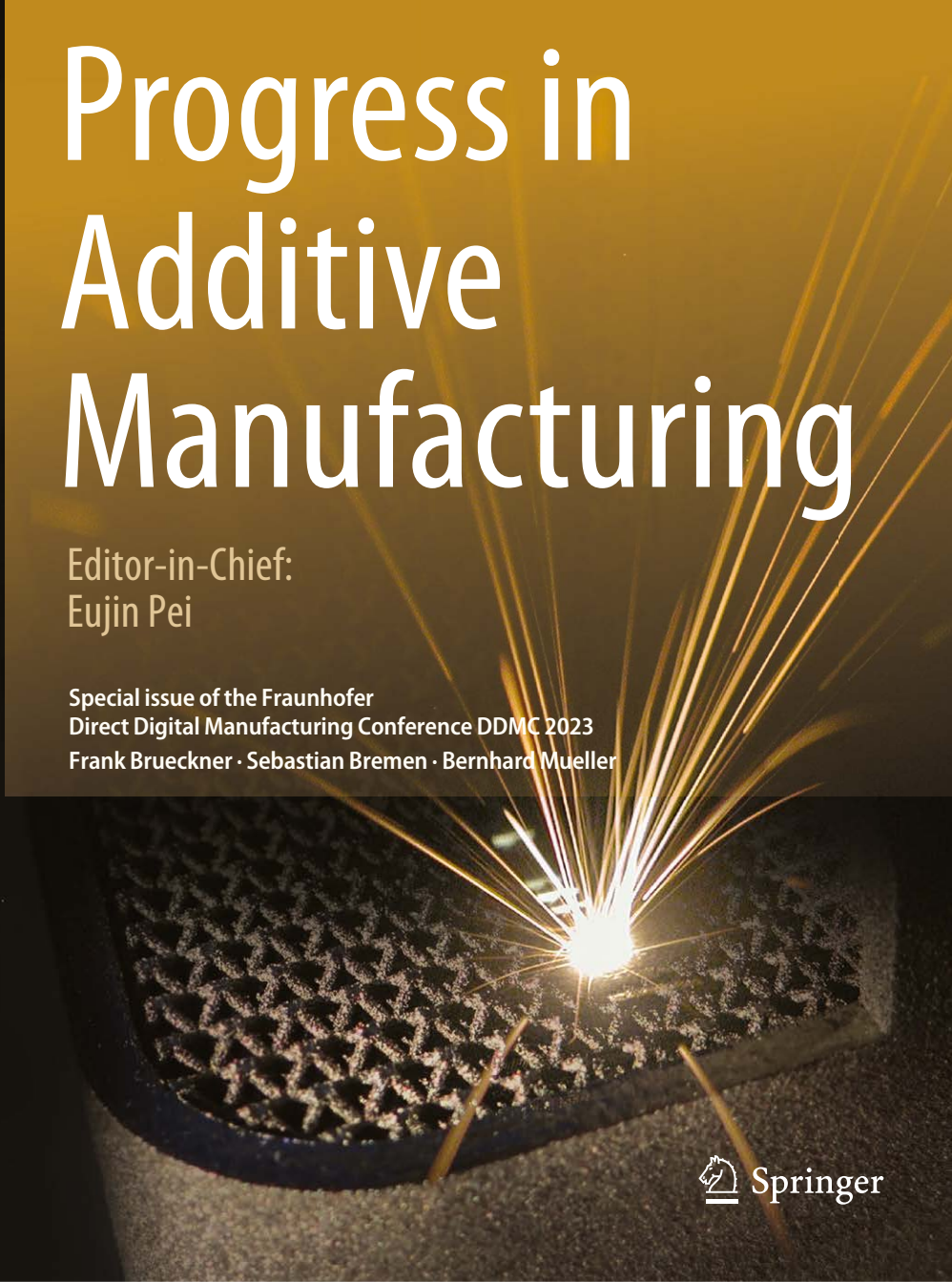
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Editor-in-Chief:
Eujin Pei

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Frank Brueckner · Sebastian Bremen · Bernhard Mueller

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ASK AN EXPERT I

What do you find most exciting about Additive Manufacturing?

DR. BARBARA IMHOF:

"AM technologies create structures that are material optimised. They offer tailored solutions that save resources and are sustainable"

DR. ÖZLEM WEISS:

"AM has the potential to shift patient-care towards highly personalized solutions from head to toe. Most people will somehow come into contact with AM. Your teeth, may have or will take the first move."

ADITYA CHANDAVARKAR:

"One of the most exciting factors about AM is that decentralizes manufacturing and allows the creation of an inventory light manufacturing business model which saves both cost and has a lower impact of carbon footprint."

PROF. MIHAELA VLASEA:

"The AM industry is a highly dynamic ecosystem, where technological and material science discoveries happen quite fast. This is a reflection of the creativity and passion of people engaged in the sector. The type of talent that AM attracts is probably one of the more exciting aspects of this industry."

SCIENTIFIC COMMITTEE

Prof. Paulo Jorge Bártolo, Nanyang Technological University, SG

Prof. Christiane Beyer, Otto-von-Guericke-Universität, DE

Prof. Richard Bibb, Loughborough University, UK

Dr. Klas Boivie, SINTEF Raufoss Manufacturing AS, NO

Tessa ten Cate, TNO, NL

Dr. Karl-Heinz Dusel, MTU Aero Engines AG, DE

Wouter Gerber, Petrawell (Pty) Ltd., ZA

Prof. Ian Gibson, University of Twente, NL

Prof. Russell Harris, University of Leeds, UK

Dr. Martin Hillebrecht, EDAG Engineering GmbH, DE

Dr. Johannes Homa, Lithoz GmbH, AT

Janne Kyttanen, What the future VC, NL

Dr. Elena Lopez, Fraunhofer IWS, DE

Ligeia Paletti, Royal Netherlands Aerospace Centre, NL

Adeline Riou, Aubert & Duval SASU, FR

Martin Schaefer, Siemens AG, DE

Dr. Bart van der Schueren, Materialise NV, BE

Dr. Cynthia Wirth, Siemens Energy AG, DE

Prof. Katrin Wudy, TU München, DE

KEYNOTE SPEAKERS



ADITYA CHANDAVARKAR

AMTech, India

»Next Engine for AM Growth - India, Asia and MEA«

An entrepreneur with business interests in diverse areas including chemicals, advanced manufacturing, innovative technology and technology marketing.

Since 2015, one of the major areas he has been involved in is the eco-system building activity for Additive Manufacturing/3DPrinting in India, Asia and the Middle East. This has led to him building industry leading knowledge sharing and business networking platforms including a trade-show (AMTech), applications specific seminars, an online platform (AM Chronicle) and training/consulting (Additive Academy).

Aditya holds a Postgraduate in Biotechnology from the University of Manchester and has also completed a Level certification on Additive Manufacturing from Purdue University.



BARBARA IMHOF

LIQUIFER Systems Group, Austria

»Solar Sintering a MoonVillage«

Dr. Barbara Imhof is a co-founder, Managing Partner and co-owner of LIQUIFER. She is working in the field of human space exploration for the European Space Agency and as part of the European Framework Programme. In her research and development project work she designs with spaceflight parameters such as limited resources, circular resource systems, minimal and transformable spaces and biological systems. She has pioneered the field of 'space architecture' in Europe and has been teaching at renowned institutes in Europe and the United States, for 20+ years. Educated in Vienna, London, Los Angeles and Strasbourg, Barbara has multiple degrees in architecture and space studies.

KEYNOTE SPEAKERS



MIHAELA VLASEA

University of Waterloo, Canada

»Digitization of the Metal Additive Manufacturing Workflow - Gaps and Opportunities«

Dr. Vlasea is an Associate Professor at the University of Waterloo, Canada, Mechanical and Mechatronics Engineering Department and the Co-Director of the Multi-Scale Additive Manufacturing Laboratory. Her research focuses on innovative design, process optimization and adoption of new materials for powder bed fusion and powder bed binder jetting additive manufacturing processes. The research goals are to bridge the technological gaps necessary to improve part quality, process repeatability and reliability.

She holds a PhD in Mechatronics engineering, with achievements in the development open architecture binder jetting and laser-based additive manufacturing systems with custom capabilities.

In recognition of her scholarly work, student mentorship, and industry outreach, she was recognised as the SME 20 Most Influential Academics in 2021 and as the SME Outstanding Young Manufacturing Engineer in 2020.



ÖZLEM WEISS

Expertants GmbH, Frankfurt/Main, Germany

»New Materials and Material Compliance in Additively Manufactured Medical Devices – Challenges & Perspectives«

Dr. Özlem Weiss is the CEO of Expertants GmbH, a service provider for development & regulatory services for medical devices in the additive manufacturing sector and Managing Director of IBD Consulting & Co., that is providing consulting services. She supported several new business & product developments in large corporations & SMEs and helped various medical device and life science start-ups as coach & evaluator. Dr. Weiss is involved in a variety of other functions. In the international network for industrial additive manufacturing MGA Mobility | MGA Medical - Mobility goes Additive she leads the working group “Medical Materials” and supports the standardization work of ISO/TC Additive Manufacturing on EU level in a mirror committee of the SBS.

She holds a PhD in chemistry and her focus has since then been materials in medical applications.

She shares her entrepreneurial knowledge as an expert, reviewer and coach at Science4Life. a business plan competition and network supporting startups in life science, chemistry and energy and as a chemist she networks with colleagues at GDCh and DECHEMA.



WEDNESDAY MARCH 15, 2023

9:15 am –
10.30 am

OPENING & PLENARY KEYNOTES

Location: Doebelin I + II

Keynote 1

**New Materials and Material Compliance in Additively
Manufactured Medical Devices – Challenges & Perspectives**

Dr. Özlem Weiss

Expertants GmbH, Germany

Keynote 2

**Digitization of the Metal Additive Manufacturing Workflow –
Gaps and Opportunities**

Prof. Mihaela Vlasea

University of Waterloo, Canada

ASK AN EXPERT II

Which key developments have taken place in AM over the last 5 years (in terms of technology, materials or applications)?

DR. ÖZLEM WEISS:

"AM evolution has achieved important milestones. The biggest steps in the last few years have been the growing number of industrially relevant polymers and alloys for AM and the solutions for process integration."



ADITYA CHANDAVARKAR:

"The three I would like to highlight are: 1) Disruption caused in the dental space, 2) Improved Patient Outcomes with Patient Specific Implants, 3) Development of Standards and Certification for the technology, materials and applications."

DR. BARBARA IMHOF:

"AM is fully integrated in space exploration and in-situ AM is being developed to a technology readiness level that will allow us to make AM one of the main technologies for construction of infrastructure on celestial bodies beyond earth."

PROF. MIHAELA VLASEA:

"Firstly, there have been advancements in industrialization of additive manufacturing technologies for scale-up. Secondly, material producers are taking a more active role in the path of discovery and material development that is custom-tailored to leverage the physics of the AM processes at hand."



SESSION 1.1

Session 1.1: Powders

Room: Doeblin I

Session Chair: Adeline Riou, Aubert & Duval

11:15 am Influence of the Humidity at Rheological Properties by Quality Control of Micro Powders

Jens Otto Woytkowiak¹, Robby Ebert¹, Tim Protzmann²

¹Hochschule Mittweida, Germany; ²Heraeus Deutschland GmbH & Co.KG, Hanau, Germany

11:40 am Assessing Powder Spreadability for Additive Manufacturing with a Rotating Drum Measurement *Industrial Contribution*

Salvatore Pillitteri, Aurélien Neveu, Marco Lupo, Stéphane Caubergh, Filip Francqui

Granutools, Awans, Belgium

12:05 pm Influence Analysis of Individual Powder Properties on L-PBF Process Capability

Philipp Kohlwes¹, Ina Ludwig¹, Arwin Kouhestani-Farouji^{1,2}, Dirk Herzog^{1,2}, Claus Emmelmann²

¹Fraunhofer IAPT, Hamburg, Germany; ²Institute of Laser and Systems Technology, Hamburg University of Technology, Hamburg, Germany

12:30 pm – 2:00 pm LUNCH BREAK

SESSION 1.2

Session 1.2: Materials (Metals)

Room: Doeblin II

Session Chair: Elena López, Fraunhofer IWS

- 11:15 am** **Dual-Laser LPBF Processing of a High-Performance Maraging Tool Steel Specialis *Industrial Contribution***
Gregor Graf
Rosswag GmbH, Germany
- 11:40 am** **AlSi7Mg0.6 Aluminium Alloy for Automotive Industry: Casting vs. PBF-LB/M**
Irina Smolina, Konrad Gruber, Karol Kobiela, Michal Karoluk, Piotr Gruber, Tomasz Kurzynowski
Center for Advanced Manufacturing Technologies (CAMT-FPC), Faculty of Mechanical Engineering, Wrocław University of Science and Technology, Wrocław, Poland
- 12:05 pm** **Production of Nickel-based Superalloy Parts by Using the MoldJet® Technology**
Robert Teuber¹, Sebastian Riecker¹, Thomas Weißgärber¹, Antti Virta², Andreas Schmid²
¹Fraunhofer IFAM, Germany; ²Winterthur Gas&Diesel Ltd., Hamburg, Germany
- 12:30 pm – 2:00 pm** **LUNCH BREAK**

SESSION 1.3

Session 1.3: Materials (Polymers and Composites)

Room: Zille Stube

Session Chair: Cynthia Wirth, Siemens Energy Global GmbH & Co. KG

- 11:15 am** **3D Printing of Lightweight “All-Polyethylene Single Component” Composite Materials Designed for Circularity**
Raimund Jaeger¹, Bernadette Schlüter¹, Christof Koplin¹, Jörg Hohe¹, Carl Schirmeister², Timo Hees³, Rolf Mülhaupt³
¹Fraunhofer IWM, Freiburg im Breisgau, Germany; ²LyondellBasell, Germany; ³Freiburg Materials Research Center, Germany
- 11:40 am** **Additive Manufacturing of Electrically Conductive TPE Material Using ARBURG Plastic Freeforming: Printability, Properties and Integration**
Stefan Pfeffer¹, Patrick Springer¹, Tobias Herrmann¹, Oliver Refle¹, Simon Leitl², Martin Neff²
¹Fraunhofer IPA, Stuttgart, Germany; ²Arburg GmbH + Co KG, Germany
- 11:05 pm** **Analytical Model for the Prediction of Young’s Moduli of Fused Filament Fabrication Structures with Variable Ply Layups**
Marlies Springmann, Peter Middendorf
Institute of Aircraft Design, University of Stuttgart, Germany
- 12:30 pm – 2:00 pm** **LUNCH BREAK**

SESSION 2.1

Session 2.1: Metal Technologies – L-PBF I

Room: Doeblin I

Session Chair: Fabian Neugebauer, Materialise GmbH

2:00 pm Additive Manufacturing and Mechanical Investigations of Novel Biomedical Ti/Nb/Ta Alloys

Bahr Fayyazi², Jan Johannsen¹, Melanie Stenzel², Markus Weinmann²

¹Fraunhofer IAPT, Hamburg, Germany; ²TANIOBIS GmbH, Goslar, Germany

2:25 pm Investigation on a Predetermined Point of Failure for Stainless Steel 316L Pressure Loaded Components Made by Laser Powder Bed Fusion Through Stress Analysis and Experimental Testing

Björn Ringel¹, David Niels Schwarz¹, Georg Schlick¹, Christian Seidel^{1,2},

Hoang Minh Vu³, Steffen Meiniger³, Matthias Oechsner³

¹Fraunhofer IGCV, Augsburg, Germany; ²Hochschule München, Munich, Germany; ³Technical University of Darmstadt, Darmstadt, Germany

2:50 pm Statistical Modelling of the Laser-Material Interaction of Ti-6Al-4V During Laser Powder Bed Fusion

Florian Bittner¹, Thomas Toeppel¹, Robert Kühne², Juliane Thielsch¹, Welf-Guntram Drossel^{1,3}

¹Fraunhofer IWU, Dresden, Germany; ²Fraunhofer IWS, Dresden, Germany;

³Technical University of Chemnitz, Chemnitz, Germany

3:15 pm – 4:00 pm COFFEE BREAK & POSTER SESSION

SESSION 2.2

Session 2.2: Extrusion Technologies

Room: Doeblin II

Session Chair: Claus Aumund-Kopp, Fraunhofer IFAM

- 2:00 pm** **Constant Volume-independent Layer Fusion in the Material Extrusion Process *Industrial Contribution***
Uwe Popp
Apium Additive Technologies GmbH, Germany
- 2:25 pm** **In-Line Measurement of Extrusion Force and Use for Nozzle Comparison in Filament Based Additive Manufacturing**
Jonas Fischer, Patrick Springer, Markus Echsel, Oliver Refle
Fraunhofer IPA, Stuttgart, Germany
- 2:50 pm** **Comparison Between Mono and Bi Component Extruders in Concrete Additive Manufacturing**
Louison Poudelet¹, Miguel Grande Molina¹, Laura Calvo Duarte¹, Roger Cardona Coma¹, Felip Fenollosa Artés^{1,2}, Roger Uceda Molera^{1,2}
¹Fundació Privada Centre CIM, Barcelona, Spain; ²Universitat Politècnica de Catalunya, Barcelona, Spain
- 3:15 pm – 4:00 pm** **COFFEE BREAK & POSTER SESSION**

SESSION 2.3

Session 2.3: Multimaterial Technologies

Room: Zille Stube

Session Chair: Russell Harris, University of Leeds

- 2:00 pm** **Evaluation of the Material Combination Tungsten (W) - CW106C (CuCr1Zr) for Additive Multi-Material Manufacturing by Laser-Based Powder Bed Fusion (PBF-LB/M)**
Thomas Bareth¹, Armin Rieser¹, Maximilian Binder¹, Alexander von Müller², Robert Lürbke², Christian Seidel¹, Georg Schlick¹
¹Fraunhofer IGCV, Augsburg, Germany; ²Max-Planck IPP, Garching bei München, Germany
- 2:25 pm** **Multi-material Additive Manufacturing Hybrid Technology to Obtain Realistic Surgical Models**
Felip Fenollosa-Artés^{1,2}, Pamela Lustig-Gainza¹, Arnau Valls-Estève^{3,4}, Lucas Krauel^{4,5}, Louison Poudelet¹, Laura Calvo-Duarte¹
¹Fundació Privada Centre CIM, Barcelona, Spain; ²Universitat Politècnica de Catalunya, Barcelona, Spain; ³Innovation Department, Hospital Sant Joan de Déu, Universitat de Barcelona, Barcelona, Spain; ⁴3D Unit (3D4H), Hospital Sant Joan de Déu, Universitat de Barcelona, Barcelona, Spain; ⁵Department of Pediatric Surgery, Hospital Sant Joan de Déu, Universitat de Barcelona, Barcelona, Spain
- 2:50 pm** **Additive Manufacturing of Strain Gauges by Laser-Based Powder Bed Fusion**
Christopher Singer¹, Maximilian Binder¹, Georg Josef Schlick¹, Johannes Schilp²
¹Fraunhofer IGCV, Augsburg, Germany; ²University of Augsburg, Germany
- 3:15 pm – 4:00 pm** **COFFEE BREAK & POSTER SESSION**

POSTER SESSION

Session Chair: Burghardt Kloeden, Fraunhofer IFAM Dresden

01 Analysis of the Machine Capability of Low-Cost FLM Printers Using ABS Filament

Carsten Schmidt^{1,2}, Patricia Kaplik¹, Rainer Griesbaum¹, Florian Finsterwalder¹, Jan T. Sehr²

¹Hochschule Karlsruhe – University of Applied Sciences (HKA), Karlsruhe, Germany;

²Ruhr University Bochum, Bochum, Germany

02 Potential of Contactless Support Structures for Improving the Part Quality of AISi10Mg PBF-LB Parts

Steffen Kramer^{1,2}, Kai Drechsel¹, Michael Jarwitz², Volker Schulze¹, Frederik Zanger¹

¹wbk Institute of Production Science, Karlsruhe Institute of Technology, Karlsruhe, Germany; ²IFSW Institut für Strahlwerkzeuge, University of Stuttgart, Stuttgart, Germany

03 Process Digitalization for Deposited Geometries in Laser Metal Deposition

Bohdan Vykhitar¹, Sebastian Hartmann^{2,4}, Malte Buhr¹, Daniel Regulin², Markus Kogel-Hollacher³, Ingomar Kelbassa^{1,5}

¹Fraunhofer IAPT, Hamburg, Germany; ²Siemens AG, Munich, Germany; ³Precitec GmbH & Co. KG, Gaggenau-Bad Rotenfels, Germany; ⁴Technical University of Munich, Materials Engineering of Additive Manufacturing, Munich, Germany; ⁵Hamburg University of Technology, Industrialization of Smart Materials, Hamburg, Germany

04 3D-Topographic Powder Layer Condition Monitoring for Improved L-PBF Process

Dennis Jutkuhn¹, Xuan Thanh Duong¹, Torben Dorbandt¹, Claus Emmelmann²

¹Fraunhofer IAPT, Hamburg, Germany; ²Institute of Laser and System Technologies, Hamburg University of Technology, Hamburg, Germany

05 Acceleration of Digital Innovations and Products by Creating a Cyber Physical Production System Engineering Network (CEN) in the Additive Manufacturing Production Environment

Fabian Tieck¹, David Hoffmann², Arndt Lüder²

¹EOS GmbH, Germany; ²Otto-von-Guericke-Universität Magdeburg, Germany

06 Thermal Optimization of Injection Molds Using Functionally Graded Materials

Thore Gericke¹, Lisa Marie Rickerts², Alexander Mattes¹, Tassilo-Maria Schimmelpfennig²

¹Kiel University of Applied Sciences, Kiel, Germany; ²Wismar University of Applied Sciences, Wismar, Germany

07 Hybridization of Materials and Technologies for the Manufacturing of Highly Functionalized and Reliable Ceramic Components for Applications Even Under Harsh Conditions

Uwe Scheithauer, Lars Rebenklau, Eveline Zschippang, Johannes Abel, Steven Weingarten, Eric Schwarzer-Fischer, Henry Barth
Fraunhofer IKTS Dresden, Germany

08 How to Boost the Relation between Standardisation Bodies, Research and Industry – EU-Project STAND4EU

Martin Schäfer
Siemens AG, Germany

SESSION 3.1

Session 3.1: Metal Technologies – L-PBF II

Room: Doeblin I

Session Chair: Katrin Wudy, Technische Universität München

- 4:00 pm** **Influence of Scan Vector Orientation on Material Characteristics and Part Quality in PBF-LB/M**
Thomas Bielefeld, Jan-Florian Käter
Premium AEROTEC GmbH, Germany
- 4:25 pm** **How to Ensure the Beam Quality of High-power Lasers in Laser Powder Bed Fusion Process *Industrial Contribution***
Nicolas Meunier
MKS Ophir, Germany
- 4:50 pm** **Investigation of the Influence of the Substrate Temperature Variation on Crack Formation by an Implemented Movable Local Heating System in the Laser Powder Bed Fusion Process**
Marco Alois Rudolf¹, Martin Leuterer², Sebastian Edelhäuser², Matthias Goldammer³, Stefan Kleszczynski⁴, Gerd Witt⁴
¹MTU Aero Engines AG, Munich, Germany; ²EOS GmbH, Krailling, Germany; ³Siemens AG, Munich, Germany; ⁴University of Duisburg-Essen, Duisburg, Germany

7:00 pm – 10:30 pm **CONFERENCE DINNER**

SESSION 3.2

Session 3.2: Functionalization in AM

Room: Doeblin II

Session Chair: Martin Schäfer, Siemens AG

- 4:00 pm** **Additive Manufacturing of Functionalized Glass Components**
Jochen Schilm, Tassilo Moritz, Dörte Wagner, Eric Schwarzer-Fischer, Steven Weingarten, Uwe Scheithauer
Fraunhofer IKTS, Germany
- 4:25 pm** **Thick-Film Technology – A Way for High Complex Ceramic AM Components**
Lars Rebenklau, Henry Barth, Uwe Scheithauer, Paul Gierth, Eric Schwarzer-Fischer, Johannes Drechsel
Fraunhofer IKTS, Germany
- 4:50 pm** **Topology Optimization for the Design of a 3D-Printed Rotating Shaft Balance**
Bram Noordman, Yoeri Ton, Jort van den Toorn, Marc de Smit, Ralph Haagsma, Tim Koenis, Wouter van den Brink
Royal NLR, The Netherlands

7:00 pm – 10:30 pm **CONFERENCE DINNER**

SESSION 3.3

Session 3.3: Industrialization and Circular Economy

Room: Ehrlich

Session Chair: Ligeia Paletti, Royal NLR

- 4:00 pm** **3D Printing of Digitally Tunable Hydrocarbon Materials Designed for Circularity *Industrial Contribution***
 René Reiser^{1,2}, Rolf Mülhaupt², Erik Licht¹, Carl Gunter Schirmeister^{1,2}, Timo Hees²
¹Freiburger Material Forschungszentrum; ²Lyondellbasell
- 4:25 pm** **Insights into the Industrialization of a Multifunctional PBF Metal Component in Medium-sized Batches *Industrial Contribution***
 Christoph Kiener
Siemens AG, Germany
- 4:50 pm** **In-situ Quality Assurance for Electron-based Additive Manufacturing by Electron Optical Observation**
 Martin Franke¹, Christopher Arnold², Carolin Körner²
¹Neue Materialien Fürth GmbH, Germany; ²Friedrich-Alexander-Universität Erlangen-Nürnberg, Chair of Materials Science and Engineering for Metals Department of Materials Science, Germany
- 7:00 pm – 10:30 pm** **CONFERENCE DINNER**



CONFERENCE DINNER @ WEIHENSTEPHANER

Wednesday, March 15, 2023, 7 pm

Join us for the DDMC 2023 conference dinner at Weihenstephaner. It is situated in the oldest building in Berlin's central »Mitte« district. Dating back to 1749, it was a gift from King Frederick William II of Prussia to writer Anna Louisa Karsch. The »Gewölbekeller« - the building's historic Vaulted Cellar – also dates back to that year. After extensive renovations in 2002/2003, these rustic vaulted halls now serve as a venue to host guests.

The evening promises to be a lively highlight of the conference and an excellent opportunity for mingling and networking with conference delegates from all over the world. Discuss hot topics, controversial presentations or just shoot the breeze with experts from a wide range of disciplines to make the most of your conference participation.



THURSDAY MARCH 16, 2023

9:00 am –
10:15 am

PLENARY KEYNOTES II

Location: Doebelin I

Keynote 3

Solar Sintering a MoonVillage

Dr. Barbara Imhof

LIQUIFER Systems Group, Austria

Keynote 4

Next Engine for AM Growth – India, Asia and MEA

Aditya Chandavarkar

AMTech, India

ASK AN EXPERT III

What big challenges is AM facing in coming years?

PROF. MIHAELA VLASEA:

"The steady trends observed over the past 5 years or so point to mergers and acquisitions of AM start-ups, which may result in disruption of an equitable innovation pipeline to the public domain."

ADITYA CHANDAVARKAR:

"Some of the technologies within AM have stabilised and the three key challenges which need to be addressed in the coming years are:
1) Scaling Up, 2) Demand Generation, 3) Lack of trained workforce."

DR. ÖZLEM WEISS:

"Regulations! Especially medical applications, where several AM players may be involved, are very challenging. We need defined interfaces and solutions for fully integrated process chains."

DR. BARBARA IMHOF:

"In space exploration AM needs to be developed into a viable, robust and secure technology which requires policy support and financial backing."

3D

5G



SESSION 4.1

Session 4.1: Industrialization and Smart Production

Room: Doeblin I

Session Chair: Klas Magnus Boivie, SINTEF Raufoss Manufacturing AS, Norway

11:00 am Additive Manufacturing – Driver of the Industrial Digital Transformation *Industrial Contribution*

Nikolai Zaepernick
EOS GmbH, Germany

11:25 am Biologically Inspired Structures for Creating Complex Wall Geometries

Stefan Holtzhausen¹, Alexander Seidler¹, Uwe Scheithauer²,
Eric Schwarzer-Fischer², Hajo Wiemer³, Kristin Paetzold¹
¹Technische Universität Dresden, Professur für Virtuelle Produktentwicklung,
Dresden, Germany; ²Fraunhofer IKT, Germany; ³Technische Universität
Dresden, Professur für Werkzeugmaschinenentwicklung und adaptive
Steuerungen, Dresden, Germany

11:50 pm Automated Post-Processing of Additively Manufactured Ti5553-Components Using Robot-Guided Blasting

Eckart Uhlmann^{1,2}, Thomas Braun¹, Christian Lahoda¹
¹Institute for Machine Tools and Factory Management (IWF), Technische
Universität Berlin, Germany; ²Fraunhofer IPK, Berlin, Germany

12:15 pm – 1:45 pm LUNCH BREAK

SESSION 4.2

Session 4.2: Quality

Room: Doeblin II

Session Chair: Karl-Heinz Dusel, MTU Aero Engines AG

11:00 am **Consider Quality – Implementing a Quality Control System in Additive Manufacturing *Industrial Contribution***

Matthias Gieseke, Nils Holzapfel
Baker Hughes, Germany

11:25 am **Concept for a Generic Modular Software Architecture for the Integration of Quality Relevant Data for Laser Sintering Machinery**

Carissa Michalkowski, Jan Christoph Janhsen, Patrick Springer
Fraunhofer IPA, Stuttgart, Germany

11:50 am **How to Boost the Relation between Standardisation Bodies, Research and Industry – EU-Project STAND4EU Overview**

Industrial Contribution
Martin Schäfer
Siemens AG, Germany

12:15 pm – 1:45 pm **LUNCH BREAK**

SESSION 4.3

Session 4.3: Production Use Cases

Room: Ehrlich

Session Chair: Cynthia Wirth, Siemens Energy Globl GmbH & Co. KG

11:00 am **Industrialize Production with Sinter Based AM Technologies *Industrial Contribution***

Simon Hoeges
GKN Additive, Germany

11:25 am **Potential of Densified Binder Jetting Gears Regarding Tooth Root Load Capacity**

Lukas Klee¹, Jens Brimmers¹, Thomas Bergs^{1,2}
¹Laboratory for Machine Tools and Production Engineering (WZL), Aachen, Germany; ²Fraunhofer IPT, Aachen, Germany

11:50 pm **Development of a Production Approach to Build a Titanium Flaperon Rib by Directed Energy Deposition**

Maria Montero-Sistiaga, Ralph Haagsma, Timo Osinga, Unai San Martin Echezarreta, Marc de Smit, Peter Nijhuis
NLR- Royal Netherlands Aerospace Centre, The Netherlands

12:15 pm – 1:45 pm **LUNCH BREAK**

SESSION 5.1

Session 5.1: Simulation

Room: Doeblin I

Session Chair: Christiane Beyer, Otto-von-Guericke Universität Magdeburg

- 1:45 pm** **Simulation of the Laser Powder Bed Fusion Process with a Holistic Workflow**
Bastien Dietemann, Tim Najuch, Shoya Mohseni-Mofidi, Alexander Wessel,
Alexander Butz, Claas Bierwisch
Fraunhofer IWM, Freiburg im Breisgau, Germany
- 2:10 pm** **Simulation Focused Digital Workflow for Optimized AM**
Industrial Contribution
Patrick Mehmert
simufact engineering GmbH, Germany
- 2:35 pm** **Virtual Assessment and Optimization of SLM Processes – Approaches to Solve the Multiscale Physics by Integrated Multiscale Simulation**
Industrial Contribution
Götz Hartmann¹, Wilfried Schäfer¹, Jesper Thorborg²
¹MAGMA GmbH, Germany; ²Technical University of Denmark
- 3:00 pm – 3:30 pm** **COFFEE BREAK**



SESSION 5.2

Session 5.2: Digital Production

Room: Doeblin II

Session Chair: Ian Gibson, University of Twente

1:45 pm **Challenges in AM Process Development, Solutions and Software-based Approaches** ***Industrial Contribution***
Jann Poppinga, Fabian Neugebauer
Materialise, Germany

2:10 pm **IP Protection, Licensing and Product Life Cycle Tracking of Additive Manufactured Products Using Blockchain Technology**
Industrial Contribution
Martin Holland, Markus Sachers
PROSTEP AG, Germany

2:35 pm **Predicting Melt Track Geometry and Part Density in Laser Powder Bed Fusion of Metals Using Machine Learning**
Maxim Kuehne, Katharina Bartsch, Bastian Bossen, Claus Emmelmann
Hamburg University of Technology (TUHH), Hamburg, Germany

3:00 pm – 3:30 pm **COFFEE BREAK**

SESSION 5.3

Session 5.3: Developments in Hardware

Room: Ehrlich

Session Chair: Burghardt Kloeden, Fraunhofer IFAM Dresden

1:45 pm **Capabilities of Wire Electron Beam Additive Manufacturing**
Industrial Contribution
Bernd Baufeld
pro-beam additive GmbH, Germany

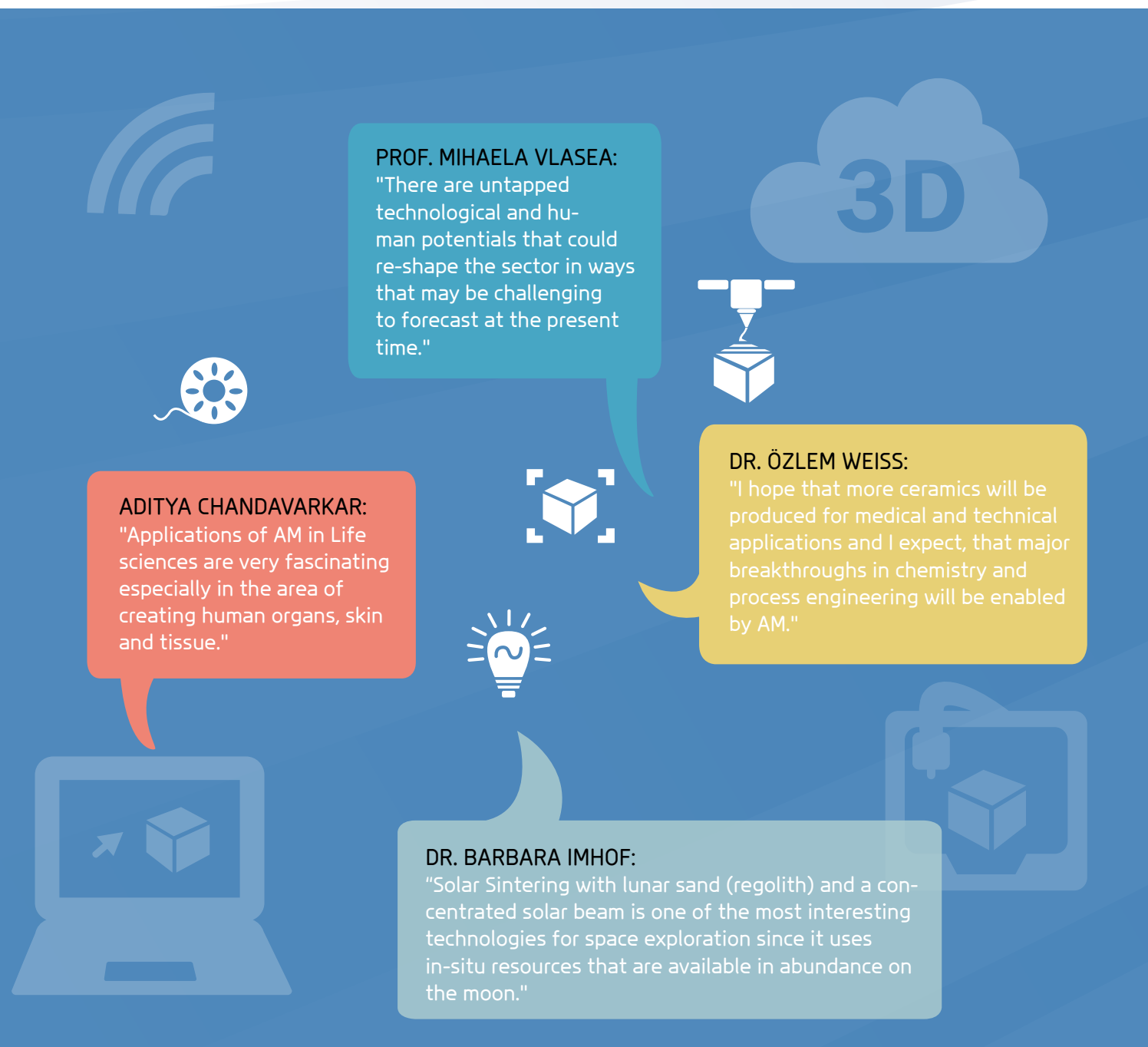
2:10 pm **Customized Alloys for Additive Manufacturing by Laval Nozzle Atomization** ***Industrial Contribution***
Christian Gerking
Nanoval GmbH & Co. KG, Germany

2:35 pm **Novel Approach to Manufacture Powders with Tailored Chemical Composition for Additive Manufacturing**
Industrial Contribution
Tomasz Choma
AMAZEMET Sp. z o.o., Poland

3:00 pm – 3:30 pm **COFFEE BREAK**

ASK AN EXPERT IV

Of the many possibilities for AM technology, which one do you expect or hope to really break through in the near future?



SESSION 6.1

Session 6.1: Printed Electronics I

Room: Doeblin I

Session Chair: Wouter Theron Gerber, Petrawell

3:30 pm

Application of Magnetoresponse Materials in 4D Printing

Stefan Junk¹, Daniel Kehret², Henning Einloth¹

¹Department of Business and Industrial Engineering, Laboratory for Rapid Prototyping, Offenburg University, Offenburg, Germany; ²Department of Mechanical and Process Engineering, Offenburg University, Offenburg, Germany

3:55 pm

Printed Electronics on 3D – Prospects and Effects of Inline IR Treatment for Robot Guided Inkjet Printing of Conductive Patterns

Robert Thalheim¹, Dana Mitra¹, Anne-Marie Kröher², Ralf Zichner^{1,3}

¹Fraunhofer ENAS, Chemnitz, Germany; ²Hochschule für Technik und Kultur (HTWK), Leipzig, Germany; ³Technische Universität Chemnitz, Chemnitz, Germany

4:20 pm –

4:45 pm

CLOSING & BEST PAPER, BEST POSTER AND BEST PRESENTATION AWARD

Location: Doeblin I

SESSION 6.2

Session 6.2: Software Platforms

Room: Doeblin II

Session Chair: Damien Buchbinder, TRUMPF Laser- und Systemtechnik GmbH

3:30 pm The Autodesk Machine Control Framework *Industrial Contribution*

Alexander Oster

Autodesk Inc., Germany

3:55 pm Trading LPBF Process Parameters and Material Data on a Digital Platform

Industrial Contribution

Ritt Stefan

Rosswag GmbH, Germany

4:20 pm – CLOSING & BEST PAPER, BEST POSTER AND BEST PRESENTATION AWARD

4:45 pm Location: Doeblin I

SESSION 6.3

Session 6.3: Printed Electronics II

Room: Ehrlich

Session Chair: Martin Hillebrecht, EDAG Engineering GmbH

3:30 pm Additively Manufactured Electronics (AME) – The Next Generation of Electronic Manufacturing *Industrial Contribution*

Alexandre Schäfer

J.A.M.E.S GmbH, Germany

3:55 pm Additive Manufacturing and Metallization of High-frequency Communication Devices

Carmen Bachiller¹, Vicente Nova¹, Álvaro Ferrer¹, Asunción Martínez⁵, Nacho Sandoval², M. Luisa Marín¹, Luis N. Ponce-González¹

¹*Universitat Politecnica de Valencia, Valencia, Spain;* ²*AIJU Technological Centre, Alicante, Spain*

4:20 pm – CLOSING & BEST PAPER, BEST POSTER AND BEST PRESENTATION AWARD

4:45 pm Location: Doeblin I

ABOUT BERLIN



BERLIN... DISCOVER THE CITY!

Some call it wild, colorful, and full of surprises, while others find it a little too hectic and gruff. Berlin is intriguing because it is so versatile and so multi-faceted. Differences are more extreme, conflicts more tangible, and problems larger than they are elsewhere. Yet even Berlin's contradictions are part of its appeal.

Since the fall of the wall in 1989, the city center around Potsdamer Platz has been completely rebuilt and rehabilitated to its former position as the city's governmental and commercial center. Many iconic buildings pepper the area, including the "Bundeskanzleramt", presently home to Chancellor Angela Merkel, and a new central railway station, Europe's largest crossing station. Germany's parliament, the Reichstag, was restored and the inclusion of its famous glass dome, designed by Sir Norman Foster, was considered by some as intended to signal a new era of social and governmental transparency.

Over 4.5 million people live in Berlin; the majority in single-person households. Berlin is Germany's, if not melting pot, then salad bowl of cultures, religions and lifestyles. Berlin counts as its own residents from more than 150 nations and is home to the largest Turkish community outside Turkey, which has led to the Kreuzberg district's nickname »Little Istanbul«.

Take a walk around the 12 districts to get the size of this multicultural city, or do like the locals and hop on a bicycle – Berlin is arguably second only to Amsterdam as Europe's cycling capital. Traditional sightseeing tours in an open double-decker bus start at Alexanderplatz, right around the corner from the conference venue.

Berlin is a leading center of science, academics, and research, not least thanks to its 39 institutions of higher education, including four universities, with more than 160,000 students. And science and industry cooperate closely at the two technology parks in Adlershof and Berlin-Buch. Germany's national research organizations are represented in Berlin with a number of institutes, among them seven Fraunhofer institutes.

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