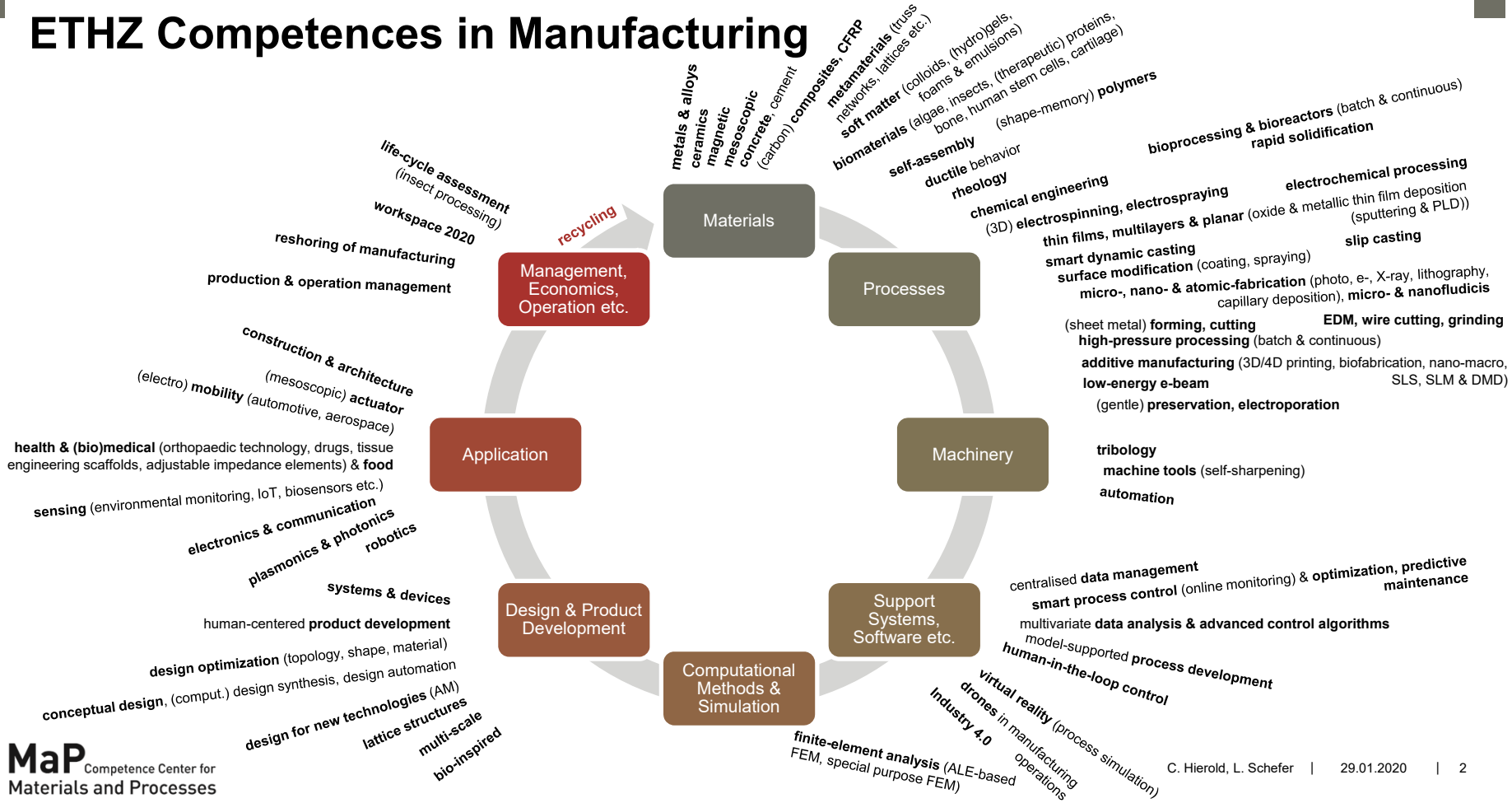
ETH zürich

SFA-AM CB & TP @ ETH Zurich

January 2020

MaP Competence Center for Materials and Processes

ETHZ Competences in Manufacturing



MaP Competence Center for Materials and Processes

ETHZ Competences in Additive Manufacturing (AM)

overview updated fall 2019

over 35 ETHZ research groups are active in AM

Materials (development, qualification, testing)
- BAUG Flatt
- HEST Zenobi-Wong
- MATL Spolenak, Löffler
- MATL Studart
- MAVT Ermanni, Shea
- MAVT Mohr
- MAVT Wegener
- inspire icams

Processes & Machinery
- MAVT Ermanni
- MAVT Mohr
- MAVT Wegener
- inspire icams

Architecture & Construction
- ARCH Dillenburger, Block
- ARCH Gramazio & Kohler
- BAUG Flatt, Habert, Vassiliou

Design & Product Development
- ARCH Block, Dillenburger, Gramazio & Kohler
- HEST Ferguson, Müller, Zenobi-Wong
- INFK Coros, Sorkine-Hornung
- MAVT Meboldt, Shea
- inspire pdz

Data, Computational Methods & Simulation
- ARCH Block, Dillenburger, Gramazio & Kohler
- INFK Coros, Hilliges, Sorkine-Hornung
- MAVT Kochmann, Mazza, Mohr
- MAVT Meboldt, Shea
- MAVT Wegener

Economics (business models & supply chains)
- MAVT Meboldt
- MTEC Brusoni
- inspire pdz

Bioprinting, (Bio)MedTech, Food & Pharma
- CHAB Leroux
- CHAB deMello, Stark
- HEST Ferguson, Müller, Zenobi-Wong
- HEST Windhab
- ITET Vörös & Zambelli
- MATL Studart
- MAVT Mazza, Meboldt
- MAVT Tibbitt

Small-Scale AM (nano & micro)
- BAUG Wang
- CHAB deMello
- HEST Ferguson, Müller, Zenobi-Wong
- ITET Vörös & Zambelli
- MATL Isa, Spencer
- MATL Spolenak
- MAVT Dual, Hierold, Nelson, Poulikakos
- MAVT Kochmann, Mohr

Publications:

MaP Competence Center for Materials and Processes

ETH Spin-Offs:

9T LABS, additively – your access to 3D printing, CYTOSURGE, SCRONA, SPECTRO PLAST

SFA Manufacturing CB & TP – update 2020

- **faculty hire Prof 'Advanced Manufacturing' at D-MAVT**
- approved ETH+ initiatives: lab for Multiscale Materials Synthesis, Fastlab, faculty hire 'Robotic Materials', RobotiX
- first candidates started in **ETH Sabbatical** | **CAS AMaP programme**
- in 2019, 3rd edition of **MaP AM Lecture Series** (with another increase in number of participants compared to previous editions in 2016/17)
- dialogue with society at **Treffpunkt Science City Spring 2019 on 'the perfect material'** & public outreach in **ETH GLOBE 'new materials'** (issue 4/2019)

ETH zürich

Professorship for Advanced Manufacturing 01.02.2020

Prof. Dr.-Ing. habil. Markus Bambach mbambach@ethz.ch

Profile:

- *Diploma in Materials Science*
  Saarland University Germany (2002)
- *Doctorate in Rapid Prototyping of Sheet Metal*
  RWTH Aachen University (2007)
- *Habilitation / Venia Legendi in Materials Technology and Shaping*
  RWTH Aachen University (2014)

Previous positions:

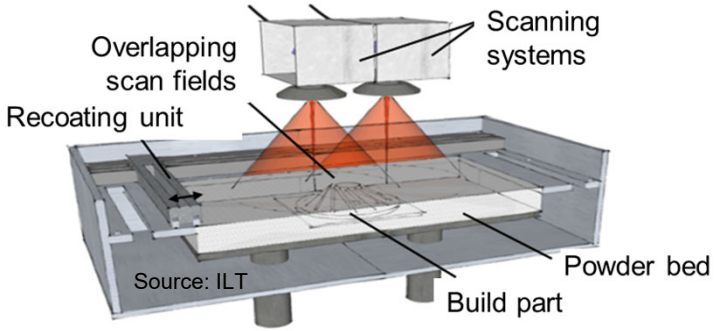
- *Brandenburg University of Technology (2015-2020)*
  - Full Professor (W3) for Mechanical Design and Manufacturing
  - CEO Panta Rhei gGmbH, lightweight materials research center
  - Coordinator of 3DLAB (15m€ research lab for additive manufacturing)
- *RWTH Aachen (2005-2015)*
  - Chief engineer, metal forming institute
  - Coordinator of the research domain “Integrated Technologies” in the Aachen Cluster of Excellence for Production

Professorship for Advanced Manufacturing

Research Interests

Selective Laser Melting:

- Multi-Laser Processes
- Temperature and property control
- High-temperature materials
- AI-assisted process control

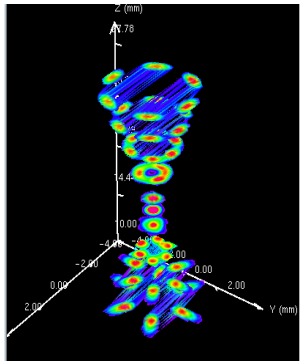


Laser Metal Deposition:

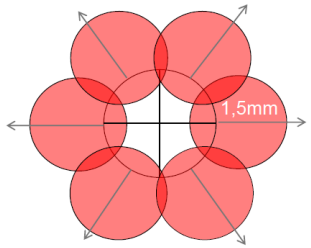
- Diode Laser system with 6 x 200 W
- Shapeable laser spot
- Coaxial feed of powder, wire and hot wire
- Superior gas shielding

prototype

laser caustic



diode laser spots



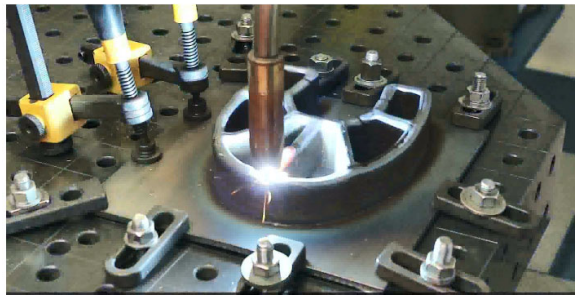
Professorship for Advanced Manufacturing

Research Interests

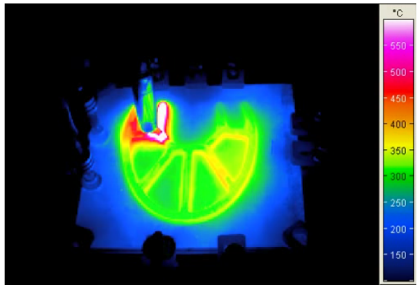
Wire-Arc Additive Manufacturing:

- Printing of large-scale structures
- Temperature & distortion control
- AI-assisted path planning

Process



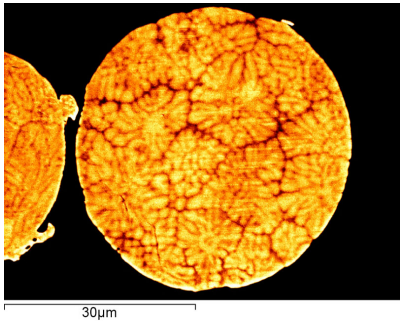
Temperature control



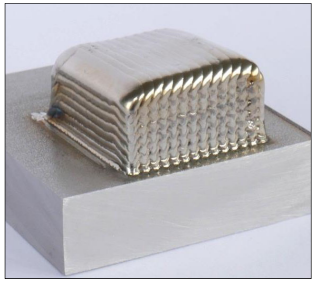
Materials:

- High-temperature materials (Ti-, Ni-, Fe-based intermetallics)
- High Entropy Alloys
- Lightweight Materials (Next Generation Scalmalloy)
- Advanced Steels
- Computational Materials Development

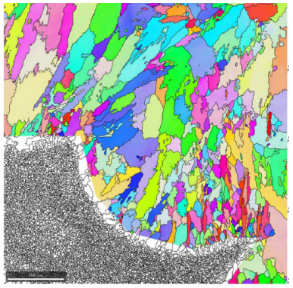
Atomized TiAl powder



Inconel (LMD)



EBSD



D MAVT
Departement für Maschinenbau und Verfahrenstechnik
Department of Mechanical and Process Engineering

additivETH 2018

1st Additive Manufacturing (AM) Mini-Symposium / Pitch Event

- **AM capacity buildup & fostering collaborations across ETHZ**
  - under auspices of Ch. Hierold
  - in collaboration with pd | z (M. Meboldt)
- 36 short talks (17 groups of 7 departm.): bigger picture & project challenges
- from nano to macro, across materials & processes, for various applications
- 75 participants

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additivETH 2019

3rd MaP Distinguished Lecture Series on ‘Additive Manufacturing’

- **expert speaker from academia & industry**
  - across materials classes & processes
  - from health to automotive to architecture
  - → tailored meeting programme at ETH
- **interdisciplinary audience of over 50 participants**
  - from all over CH
  - platform for ETHZ AM Interest Group

MaP Distinguished Lecture Series ‘Additive Manufacturing’

Interdisciplinary lecture series with internationally renowned speakers from academia & industry working at the frontiers of AM

- from nano to macro, across materials classes (biomaterials to ceramics & metals) and processes, different applications

- over 50 participants from all-over Switzerland: academia & industry

→ **platform to exchange within the ETHZ AM Interest Group**

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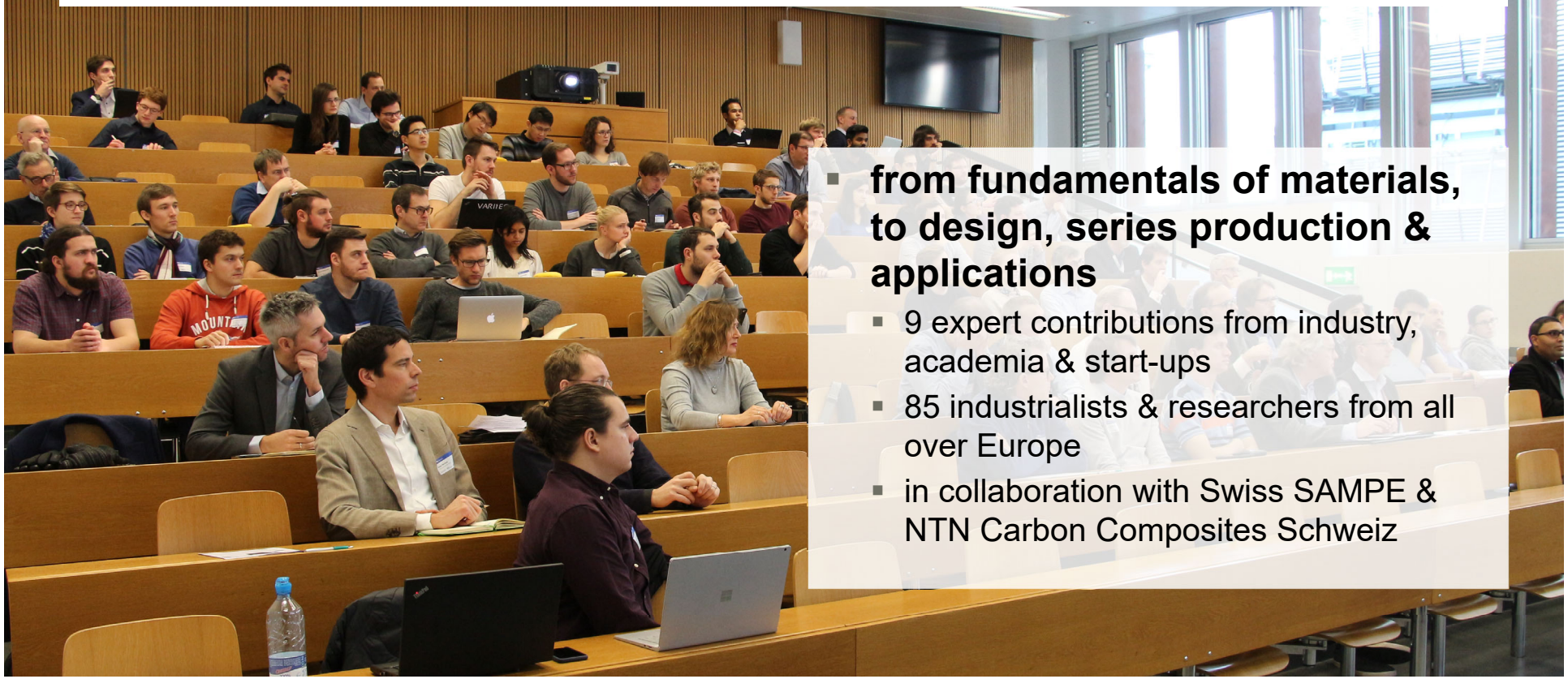
additivETH 2019

SAMPE-MaP Technical Conference ‘AM of Lightweight Composites’

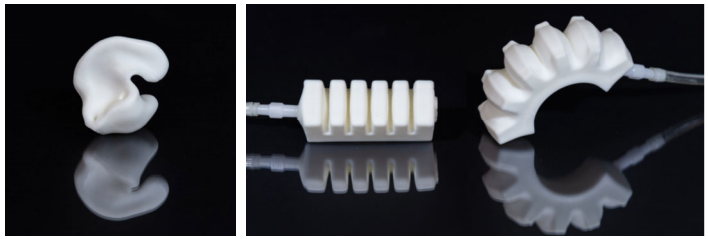


- **from fundamentals of materials, to design, series production & applications**
  - 9 expert contributions from industry, academia & start-ups
  - 85 industrialists & researchers from all over Europe
  - in collaboration with Swiss SAMPE & NTN Carbon Composites Schweiz

Further AM Activities at ETH Zurich

11.04.18	**1st AM Mini-Symposium / Pitch Event**
07.05.18	**AM Talk by Prof. Julia Greer (Caltech)**
27.-31.08.18	**1st AMB Summer School on 'AM & Biofabrication'**
25.10.18	**AM Talk by Prof. Michele Miragoli (University of Parma)**
12.12.18	**IWF-Kolloquium 'AM für grosse Bauteile'**
16.01.19	**Joint SAMPE-MaP Technical Conference 'AM of Lightweight Composites'**
14.02.19	**pd|z AM Day on 'Der Weg zum additiven Serienprodukt'**
FS 19	**3rd MaP AM Lecture Series**
24.10.19	**pd|z – AM Network Tagung 'AM in Forschung & Praxis'**
spring 20	**launch additivETH Silicone AM Platform**
FS 20	**4th MaP AM Lecture Series**
fall 20	**2nd AMPA International Conference 'AM in Products & Applications'**

additivETH Silicone AM Platform & Technology Demonstrators



aim: realising the potential of AM of soft materials for soft robotics & personalised medical technologies

→ enhance ETHZ's leading role at interface of adv. manufacturing, robotics & personalised medicine

2020 (Q1) — **setting-up of a pilot-scale technology & knohow platform** for the AM of soft materials that builds on existing ETH technology

Kick-off with 6 PIs on 27 Jan 2020

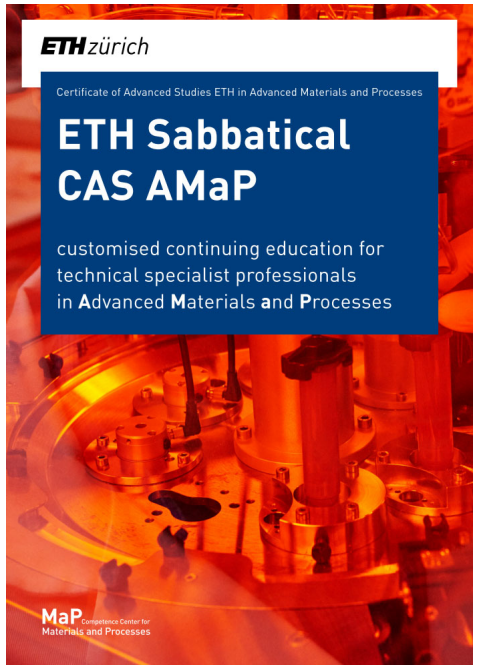
2020 (Q2) – **2021** (Q1) — **realisation of additivETH demonstrators** within 12 months by an initial group of researchers from MaP PIs, supported by community building activities

2021 (Q1/2) — **effective presentation of demonstrators** geared towards our partners in industry, clinics and media, to enhance the recognition of ETHZ's leading role in this area

2021 (Q2) – **2022** (Q2) — **rollout** (technology platform + initial users) to whole ETHZ AM community + **realisation of additional demonstrators** (open call for MaP PIs)

This project is supported by Huber & Suhner and the ETH Zürich Foundation

Lifelong Learning for Sustainable Manufacturing Innovations



ETH Sabbatical | CAS in Advanced Materials and Processes

- customised programme along individually-specified focus area
- developed in collaboration with industry partners of ETHZ

Research Project

Courses & Lectures

Knowledge Transfer

- personal coaching by MaP professor
- access to latest ETHZ research infrastructure

Thank you for your interest