EuroPM 2017
EPMA European Additive Manufacturing Sectoral Group (EuroAM)
Open meeting

Oct. 3, 2017 - Milan, Italy
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
</table>
| 16.30-16.35 | **Welcome and Introductions by the Chairmen**  
(Mr Claus Aumund-Kopp / Mr Ralf Carlström)       |
| 16.35-16.45 | **Update on the EPMA Activities**  
(Dr Olivier Coube, EPMA)                           |
| 16.45-17.20 | **EuroAM current and future activities**                                                    |
|         | • **Education, Training, Promotion and Networking** (Mrs Adeline Riou, Erasteel)           |
|         | • **Standardisation** (Mr Keith Murray, Sandvik Osprey)                                     |
|         | • **Research Projects and Innovation** (Mr Claus Aumund-Kopp, Fraunhofer IFAM)              |
|         | • **Other Activities (Benchmarking, Network with other AM organizations...)** (Mr Ralf Carlström, Höganäs Digital Metal) |
| 17.20-17.35 | **Keynote Presentation: NEW SUPREME EU Project: “Sustainable and flexible powder metallurgy processes optimization by a holistic reduction of raw material resources and energy consumption”** (Dr. Thierry Baffie, CEA Liten) |
| 17.20-17.35 | **Keynote Presentation 2: More than 3D Printing – Design – Material – Production**  
(Mr. Tobias Bretschi, APWORKS)                     |
| 17.55-18.00 | **Discussion Conclusions and next steps**  
(Mr Claus Aumund-Kopp / Mr Ralf Carlström/ All)               |
Update on the European Powder Metallurgy Association and the European Additive Manufacturing Group

October 2017

Presented by

Dr Olivier Coube Technical Director
Update on the EPMA Activities (EuroAM Group)

• Report on last EuroAM meeting and Metal AM Seminar at MTC, UK.
• Update on the EU Project **AM-motion** on “A strategic approach to increasing Europe’s value proposition for Additive Manufacturing technologies and capabilities”
• New EU Project **SUPREME** on “Sustainable and flexible powder metallurgy processes optimization by a holistic reduction of raw material resources and energy consumption”
• **Cobalt Classification Issue Update**
• New EuroAM website with a **LATEST NEWS** section.
• New Brochure on **Introduction to Additive Manufacturing Technology** (Adeline Riou)
• **PM R&D Centres** new website (Adeline Riou)
• EPMA presence in **European Exhibitions** (Adeline Riou)
• First **Club Project** on AM in the EuroAM group: SLM-POWD (Claus Aumund-Kopp)
• Second **AM Trends Survey** (Ralf Carlström)
EuroAM meeting and Metal AM Seminar at MTC

- 17 May 2017: EuroAM meeting (for 20 EuroAM members)
- 18-19 May: 2nd EPMA Metal AM Seminar (73 participants)
AM-motion EU Project (2016-2018)

A strategic approach to increasing Europe’s value proposition for Additive Manufacturing technologies and capabilities

www.am-motion.eu

- Type: CSA
- Topic: FoF-05-2016
- Project start: 1st November 2016 / Duration: 26 months
- Grant agreement n°723560
AM-motion EU Project (2016-2018)

www.am-motion.eu

The overall objective of the AM-Motion CSA is to contribute to a rapid market uptake of AM technologies across Europe.

Several Initiatives already started and more are planned:

- Regular Conferences and Workshops (AMEF 17 Oct, Brussels: http://am-motion.eu/news-events.html)
- Strategic Papers for the European Commission on Standards, Policy, Education etc...
- ...  
- End of Summer 2018: **AM Summer School to be organised by EPMA:**

An AM Summer School for Post Graduate Students will be organised with the support of AM experts and consortium partners in the second summer of the project. Duration will be around 2-3 days to exchange, spread the knowledge and give rise to vocations. [...] Trip reimbursements are foreseen for 20 students up to a threshold of €300. More students would be encouraged under own/school expenses
New EU Project **SUPREME** on Sustainable and flexible powder metallurgy processes optimization by a holistic reduction of raw material resources and energy consumption

- **SUPREME** aims at optimizing powder metallurgy processes by offering more integrated, flexible and sustainable processes for powders manufacturing and metallic parts fabrication (Mainly MIM, AM, HIP, Diamond Tool)

- **SUPREME** has gathered a consortium of 17 partners from 8 countries, represented by 11 companies (7 EPMA members)

- Budget: €9.744 Mio

- Duration: 36 months

- EPMA Role: Dissemination and Exploitation WP leader.

- More information in the next presentation from Thierry Baffie (CEA)
Cobalt Classification Issue Update

<table>
<thead>
<tr>
<th>Cobalt</th>
<th>Industry (CoRC/CDI) classification status</th>
<th>NL CLH Proposal [new]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carc. 1B H350i (carcinogenic by inhalation); GCL 0.1% Self classification</td>
<td>Carc. 1B; H350 (all routes), SCL 0.01%</td>
<td></td>
</tr>
<tr>
<td>No classification for mutagenicity</td>
<td>Muta. 2; H341</td>
<td></td>
</tr>
<tr>
<td>Repro 2; H361f Provisional self-classification pending future testing outcome (i.e. EOGRTS proposal submitted to ECHA)</td>
<td>Repr. 1B; H360F</td>
<td></td>
</tr>
</tbody>
</table>

Latest Development:
- ECHA’s Risk Assessment Committee (RAC) agreed on the new classification proposed by NL (Sept 2017, RAC42 Mtg)
- According to Eurometaux: Clear and coordinated advocacy actions and generation of Socio-Economic Analysis /bioelution data are now critical (Last Co CLH meeting on 28 Sept where EPMA participated)

EPMA support actions:
- Collected of Information on a anonymous and confidential basis (beg 2017)
- Coordinated a small Task Force to prepare the contribution of the EPMA to the Public Consultation
- Participated in the Public Consultation (Ref Number 628fab46-2c1c-4865-b758-26f049feca2d1)
- Participates in the Socio-Economic Analysis to represent the “Powder Metallurgy” sector in the Co advocacy campaign
- Launch of an user-friendly SEA Survey for EPMA members who would like to participate in the advocacy campaign (End October)
The EuroAM Website [www.epma.com/european-additive-manufacturing-group](http://www.epma.com/european-additive-manufacturing-group) will be updated and extended by a LATEST NEWS section:

- New Club Project announcements
- Workshop/Seminars programmes
- Presentations Slides of Meetings (including this one! Video recorded for EuroAM members)
- Etc ...

**Timing: End of October 2017**

Later: Tweeter/LinkedIn should complete the communication of the EuroAM Group

If you want to be informed about the EuroAM Activities and Latest News: Join the Mailing list!
EAMG Open meeting

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EAMG current and future activities: Education, Promotion & Networking

Adeline RIOU
Erasteel, France
May 2017: 2\textsuperscript{nd} EPMA « AM seminar »

- Dates: May 18-19, 2017
- Host: MTC in Coventry, UK
- 73 participants
- After the 1st AM seminar in March 2016 by Fraunhofer IFAM in Bremen, D
2018 : EPMA AM summer school for students

- Within the framework of AM Motion project
- Date Sept 2018
- Location: to be defined

An AM Summer School for Post Graduate Students will be organised with the support of AM experts and consortium partners in the second summer of the project. Duration will be around 2-3 days to exchange, spread the knowledge and give rise to vocations. Main AM concepts, existing materials and processes will be explained. In addition, design and manufacturing paradigms, market relevance and specific best practices examples will be included. Consortium industrial partners will participate as speakers.

The School will be announced on the project website and disseminated via educational establishments. Students will apply by sending their CV and explaining their interest. School organisers will select a balance between male and female candidates and nationalities. Trip reimbursements are foreseen for 20 students up to a threshold of €300. More students would be encouraged under own/school expenses.

- EPMA: Task coordinator. To organize the AM Summer School. Students selection.
- CECIMO: support to the school organisation

Contact oc@epma.com
R&D mapping project

Area: Europe

Scope: all PM technologies, of which Metal Additive Manufacturing

Status: 37 organisations registered so far for AM (out of 127 identified on metal AM)

Link: [www.epma.com/projects/r-d-centres-mapping](http://www.epma.com/projects/r-d-centres-mapping)
R&D mapping
127 institutes on metal AM

Sept 2017 (5th version)

Special thanks to our local academic contacts on the R&D mapping project

France: Florence Doré at CETIM
Germany: Claus Aumund-Kopp at Fraunhofer IFAM
Italy: Mariangela Lombardi at IIT
Spain: Iñigo Iturriza, at CEIT
Sweden: Eduard Hryha at Chalmers Univ of Technology
UK: David Brackett at MTC
And Paola Queipo, Prodintec for AM Motion project
R&D mapping project

How to register?

Link
www.epma.com/projects/r-d-centres-mapping

Help us!
Promote the EPMA database to research institutes that you know so that they register.

See also www.am-motion.eu/am-mapping/am-e-tool-database.html
The 2\textsuperscript{nd} edition of EPMA educative brochure on metal AM

October 2015 > 6000 downloads

INTRODUCTION TO ADDITIVE MANUFACTURING TECHNOLOGY

A guide for Designers and Engineers

www.epma.com

October 2017

INTRODUCTION TO ADDITIVE MANUFACTURING TECHNOLOGY

A guide for Designers and Engineers

www.epma.com/am

2nd Edition
2nd edition of EPMA brochure on metal AM: contributors

Special thanks to all the 91 contributors from industry and research
2nd edition of EPMA educative brochure on metal AM

The concept
• A visual guide on metal AM basics
  • Technologies
  • Metal Powders
  • Design Guidelines
  • Case studies
• For designers and engineers
• Link: www.epma.com/am
• 2 co-authors

What’s new?
• no. of contributors x 2: 91 vs 43
• no. of case studies x 2: 54 vs 23
• 3 new chapters added: 
  • HIP post processing
  • Non Destructive Testing for AM parts
  • Powder Handling & Safety
• Updated content in all other chapters
• A compact format: 56 vs 44 pages
Circulation of EPMA AM brochure

2015
• Advanced Engineering UK 2015 NEC, UK
• Automotive Lightweight Materials, Birmingham, UK
• EuroPM 2015
• Formnext 2015, Frankfurt, D

2016
• Develop 3D Live, Warwick University, UK
• Farnborough International Airshow, UK
• Advanced Engineering UK 2016, NEC, UK
• WorldPM 2016, Hamburg, D
• Formnext 2016, Frankfurt, D

2017
• Advanced Engineering Sweden
• Develop 3D, UK
• Automotive Council’s Lightweight Technology Roadmap, UK
• European Automotive Components Expo, D
• Advanced Engineering, UK
• EuroPM 2017, Milan I
• Formnext 2017, D
• CTI Getriebesymposium, D
More ideas?

- of collaborative actions
- regarding education, information, and promotion
- for Metal Additive Manufacturing technology

Join EuroAM working group!

Next meeting: AM Motion Experts’ Workshop on Oct 18 2016 in Brussels

Contact: oc@epma.com
EUROPM2017 – EAMG Open meeting

Oct. 3, 2017 - Milan, Italy

“Standardisation”
Developing the Powder Metallurgy Future

Courtesy of Klass Boivie, Sintef
Active Working Groups

- Standard test artefacts – New project approved
- Extrusion based additive manufacturing of plastic materials, Part 2 Process equipment – CD approved for DIS
- Standard practice for metal based powder bed fusion to meet rigid quality requirements
- Specific design guidelines on powder bed fusion
- Qualification, quality assurance, and post processing of powder bed fusion metallic parts
- NDT (Non-Destructive Testing) for AM parts
- Standard Practice/Guide for Intentionally Seeding Flaws in Additively Manufactured (AM) Parts
- New guide for anisotropy effects in mechanical properties of AM parts
- New guide for conducting Round Robin test for additive manufacturing
- New test methods for characterization of powder flow properties for AM applications
Active Working Groups

• Additive Manufacturing Cobalt-28 Chromium-6 Molybdenum Alloy (UNS R30075) with Powder Bed Fusion
• New Specification for AMF Support for Solid Modeling: Voxel Information, Constructive Solid Geometry Representations and Solid Texturing
• New Guide for Directed Energy Deposition of Metals
• New Specification for Additive Manufacturing Stainless Steel Alloy (UNS S31603) with Powder Bed Fusion
• New Specification for Additive Manufacturing Stainless Steel 17-4PH (UNS S17400) with Powder Bed Fusion
• New Specification for Additive Manufacturing Stainless Steel 15-5PH (UNS S15500) with Powder Bed Fusion
• Orientation and Location Dependence Mechanical Properties for Metal Additive Manufacturing
• Technical specification on metal powders
Even more groups....

• Technical report for the design of functionally graded additive manufactured parts
• Principles of Design Rules in Additive Manufacturing
• Additive Manufacturing AlSi10Mg with Powder Bed Fusion
• Thermal Post Processing of Metal Powder Bed Fusion Parts
• Additive Manufacturing - Material Extrusion Based Additive Manufacturing of Plastic Materials: Final Part Specification

• For details of ISO/TC 261 working groups visit:
  • https://www.iso.org/committee/629086.html
• And for ASTM F42 visit:
  • https://www.astm.org/COMMITTEE/F42.htm
Recent Publications

• ISO/ASTM 52901 Additive Manufacturing - General principles - Requirements for purchased AM parts
• ISO/ASTM DIS 52903-1 Additive manufacturing - Standard specification for material extrusion based additive manufacturing of plastic materials - Part 1: Feedstock materials

• You can access EN ISO/ASTM 52900-15 Additive Manufacturing - General principles – Terminology from the ISO website:

• To find all the published ISO standards for AM visit:
  • https://www.iso.org/obp/ui/#home
EUROPMP2017 – EAMG Open meeting

Oct. 3, 2017 - Milan, Italy

“Research Projects and Innovation”
EAMG club project “SLM-POWD”
Quality test for Laser Beam Melting (LBM) powder

• Objectives
  • study the applicability of one metal powders (to be defined) for the Additive Manufacturing process of Laser Beam Melting or Selective Laser Melting (SLM)
  • setting up a guideline on how to characterize and specify AM powder for LBM
  • setting up a guideline on how to find the right laser parameters to process powder with LBM

• Duration
  • 6 months – ending October 2017

• Lead
  • EPMA in co-operation with Fraunhofer IFAM

• 10 partners from 4 countries
Powder Test and Qualification for AM
Powder Morphologies

Production Principles

Melt atomization (gas, water)

Milling

Chemical precipitation

Electrolytic
Research on Powder Behaviour
Gaps and Challenges

- Process Robustness/Process Control
  - Powder Bed/Melt Pool Quality
  - General System Values
  - In-line Control/Closed Loop Control

- Powder Characteristics
  - Flow behaviour
  - Powder degradation
  - Powder quality control concepts

- Process Simulation
  - Thermal Models for Stress Prediction
  - Build-up Simulation for Process Prediction

- ...
Latest Developments

- Greater Variety of Materials
  - Hard Metals – Binder Jetting
  - Magnesium, Copper and Cu-Alloys
  - High Temperature Alloys
  - Special AM Alloys - Scalmalloy®

- Faster Material Build-up/Faster processes
  - Multi Beam/Multi Envelope Systems
  - More powerful Lasers
  - Larger Building Envelopes

- Improved Powder Handling

- Continuous Additive Manufacturing

- Binder Jetting is definitely back!

<table>
<thead>
<tr>
<th></th>
<th>Small Series/Prototype</th>
<th>Part Complexity</th>
<th>Productivity</th>
<th>Surface Quality</th>
<th>Resolution</th>
<th>Part Size</th>
<th>Material Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>BJ</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>++</td>
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<tr>
<td>LBM</td>
<td>++</td>
<td>++</td>
<td>+</td>
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<td>+</td>
<td>+</td>
<td>++</td>
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<tr>
<td>EBM</td>
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<td>++</td>
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<tr>
<td>DMD</td>
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<tr>
<td>MIM</td>
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<td>0</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>-</td>
<td>++</td>
</tr>
</tbody>
</table>
Binder Jetting vs. Beam Melting
Present Situation
Metal AM – Equipment Manufacturers (Binder Jetting)

US
ExOne

SE
Desktop Metal

(Desktop Metal – equipment release announced)
Present Situation
Metal AM – Equipment Manufacturers (LBM – EBM)

US
- 3D Systems

UK
- Renishaw
- Additive Industries

NL
- Arcam EBM
  the only EBM system manufacturer

DE
- Concept Laser
- SLM Solutions
- TRUMPF

Developing the Powder Metallurgy Future
Metal AM - Research Landscape in Europe

BE  sirris
CH  inspire
DK  DANISH TECHNOLOGICAL INSTITUTE
FR  aimme
ES  INSTITUTO TECNOLOGICO METALMECANICO
NL  TNO
PT  IPL
SE  swerea
UK  UNIVERSITY OF SHEFFIELD

AMRC, UK (exclusive BOEING)
EUROPMT2017 – EAMG Open meeting

Oct. 3, 2017 - Milan, Italy

“Trend survey”

72 respondents
What type of company is yours

*Other responses:
- University x4
- Steel manufacturer
- Software developer
- HIP service supplier
- AM Engineer
- Heat treatment x2
- SLM machine manufacturer

2 skipped this question
What is your company’s current AM sales range?

Skipped this question (25)
If your AM income increased, what do you feel was the main cause?

- Opened important new markets
- Added important new customers in known markets
- Produced more parts for more or less the same customers

Skipped this question (30)
According to you, what will be the trend for your AM income in the next 12 months?
Average AM Capacity used: 53%

(skipped this question) 33
Will you be adding AM production capacity in the next 12 months?

Skipped this question (24)
If you were to invest in AM machinery in the next 12 months, what technology would you invest in?

Multiple choice
Skipped this question (27)

Other
- Fused filament fabrication
- CEM – composite extrusion modeling
- Atomizer
- Powder analysis equipment
- Wire Additive Manufacturing
- PBF – EBM + LMD
- Extrusion based AM – x2
- Pressure assisted printing systems
Which AM applications are most important for your business currently and in 5 years.

<table>
<thead>
<tr>
<th>Currently</th>
<th>In 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other (please specify)</td>
<td>Other (please specify)</td>
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<tr>
<td>Industrial</td>
<td>Industrial</td>
</tr>
<tr>
<td>Luxury/ Consumer Goods</td>
<td>Luxury/ Consumer goods</td>
</tr>
<tr>
<td>Automotive</td>
<td>Automotive</td>
</tr>
<tr>
<td>Medical/ Dental</td>
<td>Medical/ Dental</td>
</tr>
<tr>
<td>Aerospace and Defence</td>
<td>Aerospace and Defence</td>
</tr>
</tbody>
</table>

Multiple choice
Skipped this question (19)
What is the main usage of your AM equipment?
What Materials do you use in your AM Process(es)?

Other answers:
- Ceramics x3
- Magnetic materials
- Tungsten alloys / composites
- Silver
- Polymers x2
- High Entopy

Multiple choice
Skipped this question 21
In your opinion, what are the main problems that slow down the widest acceptance of AM?

- Lack of international standards on properties of AM materials
- Bad quality parts supplied by some companies that damage trust on all AM companies
- Insufficient awareness of AM by customers and their designers
- Difficult to market the technology due to the lack of trained agents
- Long time to market
- Customers reluctant to access new technologies in a period of economic uncertainty
- Accessibility of alternative technologies
- Price competition from low-production-cost countries
- Technical competition with other technologies
- Price competition with other technologies

Multiple choice
Skipped this question (21)
In your opinion, which of the following EuroAM topics are the most important?

<table>
<thead>
<tr>
<th>Topic</th>
<th>Highly Important</th>
<th>Fairly Important</th>
<th>Not Very Important</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education (through documentation, training courses, website)</td>
<td>64% (32)</td>
<td>32% (16)</td>
<td>4% (2)</td>
<td>1</td>
</tr>
<tr>
<td>Research and Development (through information on new European collaborative projects)</td>
<td>60% (30)</td>
<td>38% (19)</td>
<td>2% (1)</td>
<td>2</td>
</tr>
<tr>
<td>Support to standardisation on metal powders</td>
<td>56% (28)</td>
<td>42% (21)</td>
<td>2% (1)</td>
<td>3</td>
</tr>
<tr>
<td>Promotion of AM technology (through documentation, events, participation in AM exhibitions, website)</td>
<td>34% (17)</td>
<td>54% (27)</td>
<td>12% (6)</td>
<td>4</td>
</tr>
<tr>
<td>Networking (through events and with national organisations)</td>
<td>33% (16)</td>
<td>67% (32)</td>
<td>0% (0)</td>
<td>5</td>
</tr>
<tr>
<td>Research and development (through new club projects for EPMA members)</td>
<td>31% (15)</td>
<td>65% (32)</td>
<td>4% (2)</td>
<td>6</td>
</tr>
<tr>
<td>Lobbying at European level</td>
<td>24% (12)</td>
<td>53% (26)</td>
<td>22% (11)</td>
<td>7</td>
</tr>
</tbody>
</table>

Results in % and in (number of votes)

Multiple Choice
Skipped this question (21)