EuroHIP Open Meeting

Tuesday 3rd October
16h30 – 18h00

Co-Chairs
Dr Susan Davies (Bodycote HIP AB)  Peter Henning (Quintus Technologies AB)
Overview

• EPMA activities (seminars, website, sectoral groups …)
• Trend Survey summary
• Club Projects summary
• Atlas Consortium: Feedback
  • Presented by Dr Susan Davies

• Automating Canister Design for Powder HIP
  • Dr Charley Carpenter, The Manufacturing Technology Centre (MTC)

• Metal Powders: from a “niche” approach to a commodity market
  • Mr Alain Honnart, Metalvalue
Who are the EPMA?

The European Powder Metallurgy Association (EPMA) is a non profit association formed in Brussels in 1989 with three key missions:

- Promote and Develop PM Technology in Europe
- Represent the European PM Industry within Europe and Internationally
- Develop the Future of PM

EPMA is what its members want it to be

www.epma.com/epma-objectives
Membership

EPMA members: ca. 217 Corporate + ca. 79 Individual Members

By activity

- Raw Materials: 23%
- Parts Maker: 37%
- Equipment: 17%
- Machining: 1%
- Research: 12%
- Services: 1%
- Testing: 2%
- Tooling: 1%
- Consultant: 1%
- End User: 6%

By geographical area

- Germany: 25%
- UK: 11%
- Italy: 8%
- Sweden: 7%
- USA: 7%
- Switzerland: 5%
- France: 6%
- Spain: 6%
- Japan: 3%
- Austria: 4%
- Other: 17%
EPMA Secretariat

Dr Lionel Aboussouan  Executive Director

Dr Olivier Coube  Technical Director

Mr Andrew Almond  Marketing & Exhibition Manager

Miss Kate Blackbourne  Congress Manager

Mrs Jackie Peters  Accounts and Membership Contact

Miss Scarlett Williams  Event and Project Co-ordinator

Mrs Rhianna Jones  Event and Project Co-ordinator

Ms Karen Fisher  Graphic Designer

Miss Emma Powell  Event and Administration Assistant

Mr Sam Timmis  Marketing Assistant

www.epma.com/meet-the-team
Developing the Powder Metallurgy Future

Congress and Exhibition
- Euro PM Annual Event / World PM every 2 years: EU, Asia, US
- Euro PM2018 Bilbao

Sectoral Groups

Education and Training
- Seminars
- Summer Schools
- Young Engineers Day
- PM for non PM
- PM Life

Technical work
- Benchmarking
- Statistics
- International Standards

Synergies
- Industry funded R&D programmes
- Club Projects
- EU Programme (AM Motion, Supreme)

Roadmapping
www.epma.com

Website and Guides for End Users
Spotlight on PM
Design for PM e-learning Website
Global PM Property Database
EPMA Lobbying Activities and Overview

The Lobbying Activities cover the **Environmental Health & Safety**, the **Energy and Climate Change** and the **Research and Development** areas at a European level.

The EPMA lobbying activities intend to fulfil the key mission(s) of the EPMA that are to Represent, Promote, Develop (and sometime Defend) the European PM Industry outside the PM community.

Therefore we have joined other Associations to rely on their Expertise and Network.

- **New Version of the EPMA "Vision 2025 Future Developments for the European PM Industry" Roadmap**: Useful tool for external communication
- **Developing new Standards**: The EPMA liaises between the ISO committee and the PM community

[www.epma.com](http://www.epma.com)
EPMA Social Media - LinkedIn

- Be connected with EPMA LinkedIn group
- Share post
EPMA Website for Case Studies

• [https://www.epma.com/spotlight-on-pm](https://www.epma.com/spotlight-on-pm)
EPMA News 2018

• HIP Seminar
  • 5-7 February
  • Västerås – Sweden
  • Design for HIP
    • Introduction to HIP / Introduction to HIP powder
    • High Temperature Alloys
    • HIP Modelling
    • HIP and AM
    • Case studies

• We need to attract end users for this seminar
**PM Life**

**LIFELONG LEARNING IN POWDER METALLURGY**

**PM Life** is a new lifelong training programme to help develop the Powder Metallurgy Future.

The course will offer participants the chance to either attend the full programme to learn about the whole industry or pick topics to help further their knowledge in certain areas.

The course offers five weeks training and an optional internship covering five strands.

Express your interest by contacting us on RJ@epma.com or completing a short survey at www.surveymonkey.co.uk/r/PMLifeSurvey.

Scan the QR code to enter the survey via your mobile!

www.pmlifetraining.com
HIP Trend Survey

Presented by Christoph Broeckmann
Institute for Materials Application in Mechanical Engineering (IWM)
RWTH Aachen, Germany
2017 Responses vs Historic Responses

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<thead>
<tr>
<th></th>
<th>2017</th>
<th>2016</th>
<th>2015</th>
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<tbody>
<tr>
<td>Total responses</td>
<td>24</td>
<td>26</td>
<td>30</td>
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<tr>
<td>Complete responses</td>
<td>13</td>
<td>19</td>
<td>26</td>
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</tbody>
</table>
Q4: What type of company is yours?

- Raw Materials (excluding...): 12.50%
- Powder Manufacturer: 12.50%
- Feedstock Manufacturer: 16.67%
- Equipment Supplier: 16.67%
- HIP Service: 16.67%
- HIP NNS Components...: 12.50%
- HIP End User: 8.33%
- Other (please specify): 54.17%
Q6: HIP Sales: What is your company's current HIP sales range?

- Less than 1,000,000 €
- 1,000,000 € - 5,000,000 €
- 5,000,000 € - 10,000,000 €
- 10,000,000 € - 50,000,000 €
- More than 50,000,000 €
Q7: In the last six months of 2016, how did your HIP-related income perform?

- Decreased strongly
- Decreased slightly
- Remained more or less the same
- Increased slightly
- Increased strongly
Q11: According to you, what will be the trend for your income in the next 12 months?

- Strong increase
- Slight increase
- More or less the same
- Slight decrease
- Strong decrease
Q12: How do you rate your HIP-related business nowadays?
Q13: How do you see the trend of your HIP-related business over the next 12 months?
Q21: Please enter your approximate sales percentage by sector (value)

- Aerospace, 23%
- Automotive, 4%
- Consumer Goods, 2%
- Medical, 3%
- Oil & Gas, 11%
- Energy (not Oil & Gas), 32%
- Others, 18%
- Tooling, 8%
Q22: Geographical breakdown of sales (percentage)

- Home country: 66%
- EU (27): 17%
- Europe non EU 27: 0%
- North America: 9%
- Asia: 8%
Summary

• The HIP related business seems to run at a stationary value.
• The companies are slightly more optimistic compared to 2016.
• Regarding regional markets: Home country market is the main market for HIP. Only some companies are selling outside of Europe.
• Energy, Aerospace and Oil&Gas seem to be the biggest markets. The aerospace market seems to be the most interesting market for HIP.
• The acceptance of HIP gets impeded mostly by little awareness in the design but also by lack of standards and the price competition with other technologies.
EPMA Club Projects

Industry-defined Projects open to EPMA Members and Co-ordinated by the EPMA

- Budget: Between €10k and €100k
- Time frame: Between 6 and 18 months
- 19 Projects so far: www.epma.com/projects
- €650k collected in total

Club Projects Webpage:
www.epma.com/projects

Funding from Industry Partners

Project Ideas from Universities, R&D Centres and Contractors

Co-ordination by the EPMA

Club Projects Webpage:
www.epma.com/projects
Proposal for an EPMA club project:

**AM&HIP 18**

Combination of Additive Manufacturing and HIP

Christoph Broeckmann, Johannes Kunz

Institute of Applied Powder Metallurgy and Ceramics at RWTH Aachen University, (IAPK)

EuroHIP Sectoral Group Meeting, Milan, October 3, 2017
Motivation (1)

Microstructure of alloy F75 as SLM

relative density in the as-SLM state: 99.7%
Motivation (2)

Microstructure of alloy F75 as SLM + HIP

relative density in the as-SLM + HIP state: 100 %
Endurance limit of alloy F75 in different production routes

endurance limits:

- as cast: $\sigma_{A50} = 296$ MPa
- as SLM: $\sigma_{A50} = 123$ MPa
- SLM+HIP: $\sigma_{A50} = 470$ MPa
Motivation (4)

• The costs for SLM scale with the scanning speed of the laser beam.

• The speed can be increased when no full density is required.

• Post densification by HIP reduces porosity

\[\text{Combination of SLM + HIP gives a potential for an optimum in terms of production costs}\]
Objectives

1. Identification of a set of HIP parameters to obtain full density and optimal mechanical properties in components produced by SLM

2. Determination of the increase in fatigue strength that can be obtained by adding a HIP cycle to the SLM-process

3. Optimization of the entire process chain: SLM + HIP in order to get a solution with minimum process costs and maximum performance regarding mechanical properties
Work Packages

WP 0 | Powder supply | industry
---|---|---
WP 1 | Production of specimens by SLM | IWM
WP 2 | Post densification by HIP | IWM
WP 3 | Heat treatment | IWM
WP 4 | Characterization of density and microstructure | IWM
WP 5 | Fatigue tests | IWM
WP0: Powder Supply

- two grades to be specified by the industrial consortium, for example
  - Steel base 17-4PH, 316L, 2507 Duplex
  - Super Alloy IN718
  - CoCr ASTM F75
  - Tool steel H13, M2

- powder to be supplied by industry
WP1: Production of Specimens by SLM

- iterative identification of optimal SLM-parameters by cube shaped specimens
  - available SLM machine: Realizer SLM100
- production of specimens for fatigue tests (rotating-bending-tests)
- production of cube shaped specimens with different density due to variation of SLM-parameters
WP2: Post Densification by HIP

- 12 HIP cycles
  - 6 per material
- variation of HIP parameter
  - Pressure, Temperature and Dwell time

ASME Metals Handbook, Vol. 7
WP3: Heat Treatment

depending on the particular material:

• no heat treatment

• harden and temper (tool steel)

• solutionize (austenitic steel, duplex steel)

• solutionize + aging (super alloy, maraging steel)
WP4: Characterisation of Density and Microstructure

- investigation in the „as SLM“ and as „SLM+HIP“ state
- density measurement by He-pycnometry and Archimedes principle
- Light optical micrographs in order to determine porosity and grain size
- SEM in order to identify crack origins in the fracture surface
WP5: Fatigue tests

- rotating bending tests

- for each grade:
  
  2 S-N-diagrams (Wöhler-curve)

  statistics: 30 specimen each

- Comparisson of endurance limits of two states:
  
  - as SLM
  
  - as SLM + HIP
**Work Package Time and Planning**

- **Duration of the project:** 10 months

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<tr>
<th>Work Package</th>
<th>month 1</th>
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<th>month 3</th>
<th>month 4</th>
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<th>month 7</th>
<th>month 8</th>
<th>month 9</th>
<th>month 10</th>
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<td>WP1 Production of specimens by SLM</td>
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<td>WP2 Post densification by HIP</td>
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<td>WP4 Characterization of density and microstructure</td>
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<td>WP5 Fatigue tests</td>
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**KM:** Kick-off meeting,  
**IM:** Interim Meeting,  
**FM:** Final Meeting
## Cost Figure

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
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<tbody>
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<td>IAPK personnel:</td>
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<tr>
<td>0.2 full engineer for 10 months:</td>
<td>10,400 €</td>
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<tr>
<td>0.3 technician for 8 months:</td>
<td>9,750 €</td>
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<tr>
<td>1.0 Student for 10 months</td>
<td>5,500 €</td>
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<tr>
<td>Overheads on personnel</td>
<td>15,390 €</td>
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<tr>
<td>Consumables (metallography, SLM, fatigue testing)</td>
<td>6,000 €</td>
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<td>HIP cycles (personnel included above)</td>
<td>6,000 €</td>
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<td>Travel costs (3 meetings à 2 persons)</td>
<td>2,400 €</td>
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<td><strong>Total funding</strong></td>
<td><strong>55,440 €</strong></td>
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<td>EPMA administrative costs (15%)</td>
<td>8,316 €</td>
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<td><strong>Total costs of project</strong></td>
<td><strong>63,716 €</strong></td>
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All costs exclusive VAT if applicable
Next step

• Meeting Wednesday 12h15 – 12h45
• Contact Rhianna Jones if you are interested to join this Club Project
  • rj@epma.com
Atlas consortium on HIP

- Presented by
- Dr Susan Davies
  (Bodycote HIP AB)
Automating Canister Design for Powder HIP

• Dr Charley Carpenter
  The Manufacturing Technology Centre (MTC)

• For these slides please go to
• https://www.epma.com/european-pm-hot-isostatic-pressing-group
From a Niche Approach to a Commodity Market

- Mr Alain Honnart
  Metalvalue

- For these slides please go to
  - https://www.epma.com/european-pm-hot-isostatic-pressing-group
If you have any questions regarding the meeting or the EuroHIP group please contact Rhianna Jones: rj@epma.com