Die Hardfacing and Remanufacturing using Direct Metal Deposition (DMD)

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POM Group, Inc., Auburn Hills, MI-48326
OUTLINE

• Company
• Overview of Direct Metal Deposition
• DMD Systems
• DMD Application in Dies : Case Studies
  – Metal Trimming
  – Forging
  – Extrusion
  – Aluminum Die Casting
  – Plastic Injection Molding
• Summary
The POM Group Inc. is a minority owned company located in Auburn Hills, Michigan.

The POM Group provides:

- **Service**: Provide engineering product development services
- **System Integration**: Manufacture DMD® systems
- **R&D**: Develop, support, and innovate DMD® process

**ISO 9001 : 2008 Certified**
DMD Process Overview
DMD System Overview

Conceptualization → CAM tool path → CAD Data

Product → Closed Loop DMD
DMD Process Overview

Blending of 5 common technologies

- Laser
- CAD/CAM
- CNC/Robot
- Sensors
- Powder Metallurgy

High power laser builds parts layer-by-layer out of gas atomized metallic powder
Closed Loop Feedback Controller

Feedback Controller controls dimensional integrity

Outer Diameter of Cylinders : 25.4 mm
DMD Advantage

- Closed Loop Control: Shorter HAZ, better quality in remanufacturing
- Moving optics: allows large part processing
- DMDCAM: 5+1 axis additive manufacturing software
- DMDVision: Automated part pick-up and toolpathing for turbine components
## DMD Materials

### Substrate Compatibility

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<tr>
<th>DMD Material</th>
<th>Tools steels</th>
<th>Stainless steels</th>
<th>Low-C steels</th>
<th>Cast Iron</th>
<th>Ni-alloys</th>
<th>Co-alloys</th>
<th>Cu-alloys</th>
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Our Systems provide....

- Turnkey Integration
- Patented Nozzles
- Patented Closed Loop
- CO₂, Diode, Disc Lasers
- 5 Axis Moving Optics
- CNC and Robot Platforms
- Small to Large Work Area
Applications in Industry

REMANUFACTURING  SURFACE PROTECTION  RESTORATION

FABRICATION  MANUFACTURING  PRODUCT ENHANCEMENT
Trimming

Trim Steel upgraded DMD Superalloy
## Trim Die hard-facing

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<th>Field Performance</th>
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<tr>
<td><strong>DMD Die</strong></td>
<td>1800 hits with 1 rework</td>
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<tr>
<td><strong>Conventional Die</strong></td>
<td>2000 hits with 3-4 rework</td>
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**Stellite 22D on edge and H13 substrate**
Forging Dies
Forging Die Hardfacing

- **Technical challenge**
  Severe wear and heat checking

- **Laser (DMD) solution**
  Stellite 6 on S7
  - Tool life before: 5,000 cycles
  - Tool life after: 19,000 pieces
  - **Tool Life Improvement: 4X**
Extrusion Dies
Plastic Injection Molding
Steel Clad

Technical challenge
- Dissimilar material
- Improved surface wear resistance
- Increase cooling rate

Laser (DMD) solution
- H13 on AMCO 940
- Process limitation for Internal stress

Economic impact
- Reduced cycle time by 26%
- Yearly saving $60,000/year
- ROI in 1 year
Frequently Asked Questions

- Deposition Rate: 16 to 320 cm$^3$/hr
- Deposition Speed: 500 to 2400 mm/min
- Beam Diameter (spot size): 1mm to 5mm diameter
- Layer Thickness: 0.1 mm to 1.6 mm
- Hardness: Fully Hardened “as-quenched”
- Powder Efficiency: 40 to 80 % (product dependent)
- Post-DMD Machining: CNC/EDM/Grinding
Summary

- DMD technology: converts “CAD to Part”
  - Optical feed back system: Near Net shape components
  - Dissimilar material cladding
  - Wide range of scale ($10^{-5}$m - $10^{-1}$)
  - DMDCAM for 5-axis deposition
  - DMDVision system

- Remanufacturing worn out/damaged die
- Die life extension by DMD applied hardfacing
- High productivity using bi-metallic tooling
THANK YOU

Visit our Website for more information & downloads at

WWW.POMGROUP.COM