APPLING CERMET (WC) COATINGS VIA INTERNAL BORE LASER CLADDING

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Outline

- Introduction
- Internal Bore Laser Cladding
- Previous work on WC
- Glass Tooling
- Single Bore (Extrusion)
- Twin Bore
- Cracking Issues
- Results
- Conclusions
Internal Bore Laser Cladding (IBLC)
Internal Bore Laser Cladding (IBLC)
Current IBLC Capabilities

- Reach 16in depths
- Clad a minimum of 2.75in diameter bores
- Withstand 1300°F environment
- Deliver approximately 2kW to the internal surface of components
- Deliver 60g/min of powder material
- Approach surface velocities of 80in/min
Future (4/2012) IBLC at QCML

- 3 KW IPG fiber laser
- 3 axis gantry with coordinated rotary table
  - 2’ diameter work area
  - 200 pound load
- IBLC head – 2” ID – 20” long
- Twin 10 powder feeder
NiCr-WC (60%) Wear Resistant Materials

NT-60 (Carpenter)

TL 60 (Technegenia)

NiCr 60WC (Kennametal)

TL60 Wear Test Pad (06-023-01)
Wear Testing Results (ASTM G65)

ASTM G65 Abrasion Data

<table>
<thead>
<tr>
<th>Hard Chrome Plating</th>
<th>NT-60</th>
<th>NT-70</th>
<th>NTCr-70SP</th>
<th>NTCr-70IC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Adjusted Volume Loss (mm³)</td>
<td>9.00</td>
<td>5.00</td>
<td>3.00</td>
<td>2.00</td>
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</tbody>
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Dilution Issues

Double Layer NiCr-WC Clad
WC Reaction with Iron
Source Material Issues

- Entrapped Gaseous Porosity
- Size and Distribution
- Fluidity
- Morphology
- Low Vapor Pressure Elements
- Moisture (affects porosity and fluidity)
Cladding Response
Cladding Response
Cladding Response
Cladding Response
Glass Forming Tooling
Carbide Type (Coarse vs fine)
Carbide Dispersion

Excess Dilution

Very Low Dilution
Internal Bore Cladding
Internal Bore Laser Cladding

- Internal Bore Laser Cladding (Xaloy)
  - Application (Plastic Injection Molding Barrels)
  - Improved Performance to extend Barrel Life
  - Solution: LAM with 70% WC in NiCrSiB Matrix
Single Bore

Currently HIP clad with a 70% WC
Single Bore
Single Bore
Twin Barrels
Twin Barrels
Twin Barrels
Twin Barrels
Twin Barrels
Cracking Issues

Transverse Crack

Center-Line Crack

Transverse Crack

Underbead Crack
Cracking Issues

Higher Heat
Imaging for Crack Mitigation

Hydraulic Cylinder Chrome Replacement

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High Temperature Imaging

Hydraulic Cylinder Chrome Replacement

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Crack Mitigation

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Agricultural Applications

What are the possibilities?

- Thin film coatings
- **Thick film coatings**
- Solid sintered parts
- Bulk powder additive

$2.3B
Industrial Equipment (a few)

- Earth Moving – Wear Coatings
- Oil & Gas – Hydraulic Cylinders
- Plastics – Extrusion Barrels & Screws
- Transportation – Wear Surfaces
- Metal Processing – Tooling Surfaces
- Paper Industry – Saw Blades & Cutters
- Defense – Wear & Cr Replacement
- Aerospace – Landing Gear
Summary

- Need to understand limitations and specifications for source powders
- Must understand Effects of Process Parameters on dilution
- NiTung60 should be adequate for Cr replacement
- NiTung70 being proposed for extrusion barrels
- Many Industrial Applications for LAM WC MMC’s
- Xaloy with help from QCML and AML is opening shop for your applications.
Thank You