High Toughness Cermets for Molten Salt Pumps

Powdermet Inc

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Project Team

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Key Challenge

• High temperature, corrosive salt
• high dynamic loads
• aggressive environment for CSP pumps
• Superalloys lack corrosion resistance and ceramics lack formability and toughness
• Most materials have insufficient strength at 720°C
Proposed Solution

- CERMET (Ceramic Reinforced Metal) offers a balance of corrosion resistance, strength, toughness
- Coat cermet on high temp substrates and
- mold, weld, machine cermet components
- an economical material solution for CSP pumps

HybriMet™ Metal Matrix Composite

<table>
<thead>
<tr>
<th>Property</th>
<th>Method</th>
<th>Cond</th>
<th>Units</th>
<th>NiWC3b</th>
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<tbody>
<tr>
<td>Rockwell Hardness</td>
<td>ASTM E18</td>
<td>RT</td>
<td>HRC</td>
<td>68</td>
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<tr>
<td>Flex Strength</td>
<td>ASTM C1161</td>
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<td>Mpa</td>
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<tr>
<td>Bulk Fracture Toughness</td>
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NIWC3 sample exposed to MgCl\textsubscript{2}KCL at 750°C for 250 Hours. Very little attack and particles look to be intact and stable to the salt. The Nickel and Tungsten Carbide are clearly visible.
Technical Approach

- Establish application relevant material design data
- Validate component fabrication processes
- Build molten salt tribology test bed
- Build and run a validation pump
- Design and quote Gen 3 demonstration pump
1. A laboratory validated pump design, vendor and quotation for Gen 3 demonstration
2. Material design data and additional material choices for pump suppliers
3. A tribology test bed for rapid evolution of molten salt capable materials

Expected Impact

- Liquid path risk reduction
- Reduced cost
- Reduced time for insertion of improved materials
A validated nanocomposite material for molten salt pumps

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