U.S. DEPARTMENT OF ENERGY | Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

SOLAR ENERGY TECHNOLOGIES OFFICE

SETO CSP Program Summit 2019

High Toughness Cermets for Molten Salt Pumps

Powdermet Inc

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Project Team

POWDERMET INC.
MAKING MATERIALS DO MORE

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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^{o}C

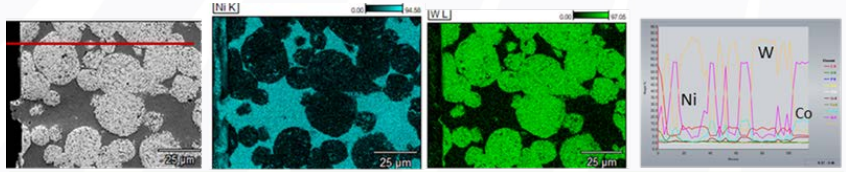
Proposed Solution

- 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

Typical Properties

				Cermet
Property	**Method**	**Cond**	**Units**	**NiWC3b**
Rockwell Hardness	ASTM E18	RT	HRC	68
Flex Strength	ASTM C1161	RT	Mpa	1180
			Ksi	171
Bulk Fracture Toughness	ASTM C1421	RT	Mpa*m$^{\Lambda 1/2}$	19.9



NiWC3 sample exposed to MgCl:KCL at 750C 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

Expected Impact

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

- **liquid path risk reduction**
- **reduced cost**
- **reduced time for insertion of improved materials**

Expected Impact

A validated nanocomposite material for molten salt pumps

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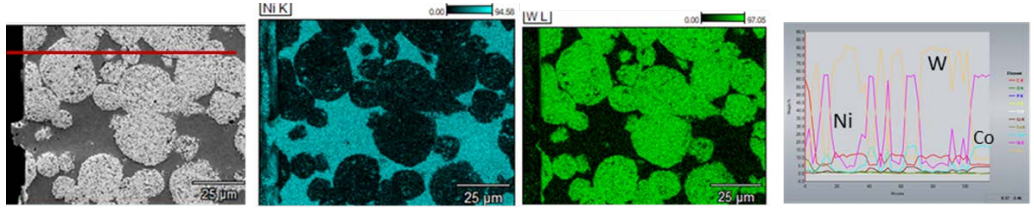

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