College of Engineering
Department of Mechanical & Industrial Engineering

College of Engineering
School of Electrical Engineering & Computer Science

To Predict ▶ To Design ▶ To Perform

ME, ECE Capstone Design Programs

Team 14: System For Making Metal Alloy Powders

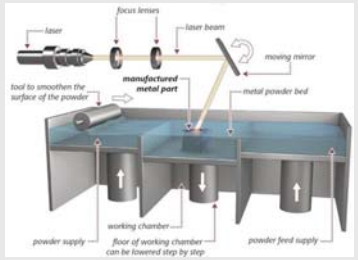
Tim Dwyer (ME), Cameron Falgoust (ME), Lauren Foley (ME), Shi Jin (EE), Abel Lopez (EE), Nic Rayneri (ME), Cameron Triay (ME), Qing Wang (E

Project Objective

- Design and fabricate a Rotating Electrode Atomization System (RES)
- Utilize a 1" diameter shaft in a 60k RPM spindle
- Generate 316SS & Ti64 powder ≤50 µm OD with ≥50 wt% yield without surface oxidation

Background

- Selective Laser Melting (SLM) is an additive manufacturing process that melts and fuses metal particles together.
- These particles must be ≤50 µm to be useful in SLM

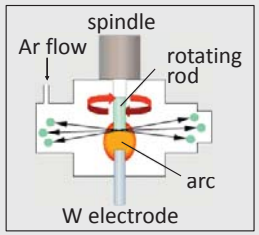


Specifications and Results

• Achieve powder size ≤50 µm	✓
• ≥50 wt% yield at desired size	Not possible w/o 60k RPM spindle
• Rotate 1" OD rod at 60k RPM	
• Create 316SS/Ti64 powder	✓
• Semi-automatic vertical control	✓
• Maintain ≤0.01% O_2	✓
• Collect created powder	✓

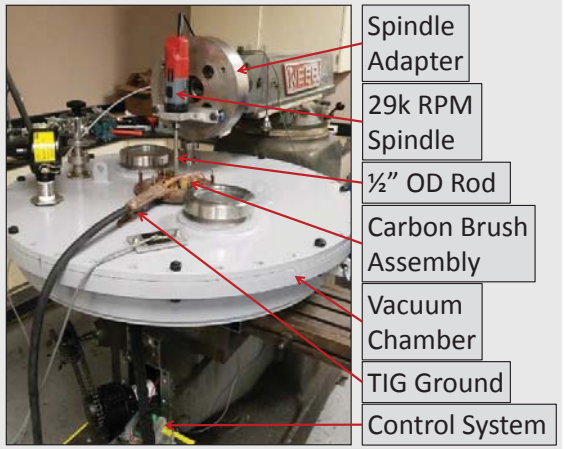
Embodiment

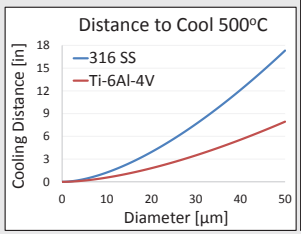
- A rod is rotated at high speed and arced by a tungsten electrode
- Melted particles launch radially and solidify before hitting chamber
- A vacuum is pulled to purge the chamber, then Argon is flowed in during operation to prevent surface oxidation



- As the rod melts away, the chamber is raised vertically to keep a constant arc gap
- Below shows design synthesis with 29k RPM spindle after 60k RPM spindle bearing failure

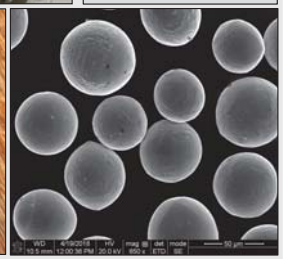
60k RPM spindle





Convection Analysis

316SS Powder



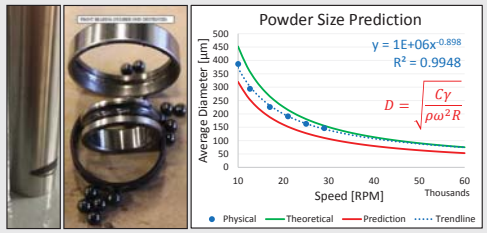
SEM Image

Safety

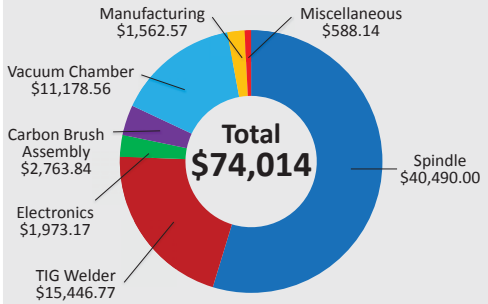
- PPE: eye protection, respirators, and gloves
- 2 Lexan safety walls
- Proximity probe kill switch
- Vibration detection circuit

Testing and Validation

- 60k RPM spindle bearings failed during vibration circuit testing
- Particle size vs. speed tests were run to validate original design parameters



Budget



Definition — Concept Generation — Engr Analysis — Procurement — Manufacturing — Assembly — Testing and Validation

September — October — November — December — January — February — March — April — May

Sponsor: Dr. Shengmin Guo

Adviser: AJ McPhate