# Team 14: System for Metal Powder Production

**Aaron Alford (ME), Brennen Brown (ME), Ling Fang (ME), Michael Guidry (ME), Kris Meche (ME)**

## Project Objectives

- Produce a working proof of concept system.
- Produce Titanium 64 & 316 Stainless Steel powder.

## Background

Selective Laser Melting (SLM) is a method of additive manufacturing for metal components. SLM requires fine metal powders (diameters of 10-45 micrometers) that are also round and free of oxidation to ensure complete melting, solidification, and purity of each substrate layer. Small scale powder creation schemes are sought for quickening and lowering cost of SLM research.
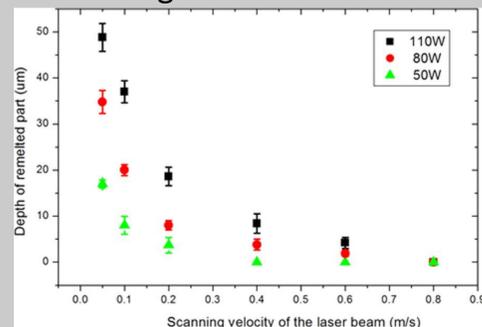


*Fig. 1 – Laser Penetration Depth vs Scanning Speed in SLM*

## Validation

| Specifications | Results |
|---|---|
| < 1% $O_2$ Concentration | < 0.25% $O_2$ (4.5 minutes) |
| Round, Smooth | Spherical, 0% oxidation in both |
| 10-45 micron diameter | 6-8% yield, above target 5% |

## Safety

- Respirators and gloves worn when handling powder.
- Shielding installed to prevent dust and spark escape.

## The Prototype System
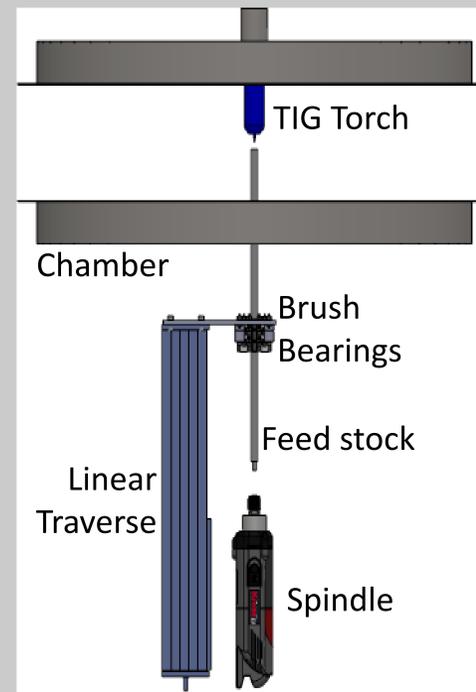


*Fig. 2 – Physical Prototype*



TIG Torch

Chamber

Brush Bearings

Feed stock

Linear Traverse

Spindle

*Fig. 3 – Major Components*



*Fig. 4 – Input (L), Product (R)*

## Budget

### Available - $14,000 | Used - $4,790.75

| | |
|---|---|
| Oxygen Sensor | $1,227 |
| Linear Traverse | $1,274.97 |
| TIG Torch | $688.52 |
| TIG Accessories | $332.08 |
| Exhaust Filter | $94.91 |
| Feedstock | $149.04 |
| Carbon Brushes | $150.30 |
| Chamber | $657.02 |
| CNC Work | $40 |
| Waterjet Work | $15 |
| Fasteners | $102.94 |
| Miscellaneous | $58.97 |

## Results
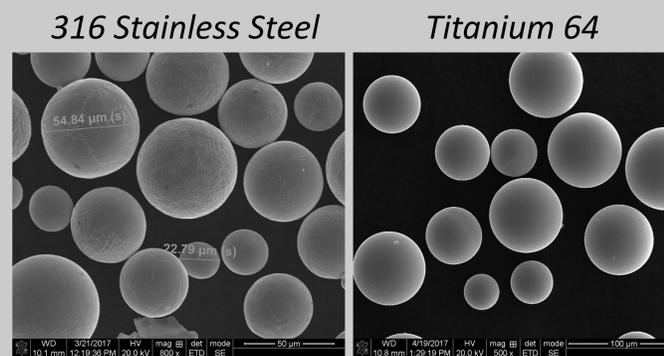
316 Stainless Steel          Titanium 64



*Fig. 5 – Scanning Electron Microscope scans of powder showing superb quality*
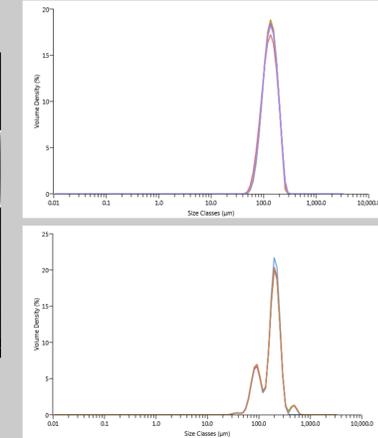


*Fig. 6
Powder size distribution.
SS316 (top)
Ti64 (bot)*

*Median diameter (μm)
→ SS316 - 132
→ Ti64 - 188*

Concept Gen. (9/16-10/16) → Embodiment (10/16-10/16) → Analysis (10/16-12/16) → Redesign (12/16-1/17) → Procurement (1/17-2/17) → Manufacturing & Assembly (1/17-3/17) → Redesign (3/17-3/17) → Testing (3/17-4/17)