Dog-Bone of the Week Presentation
Monday, March 7th, 2022

Gas Atomization

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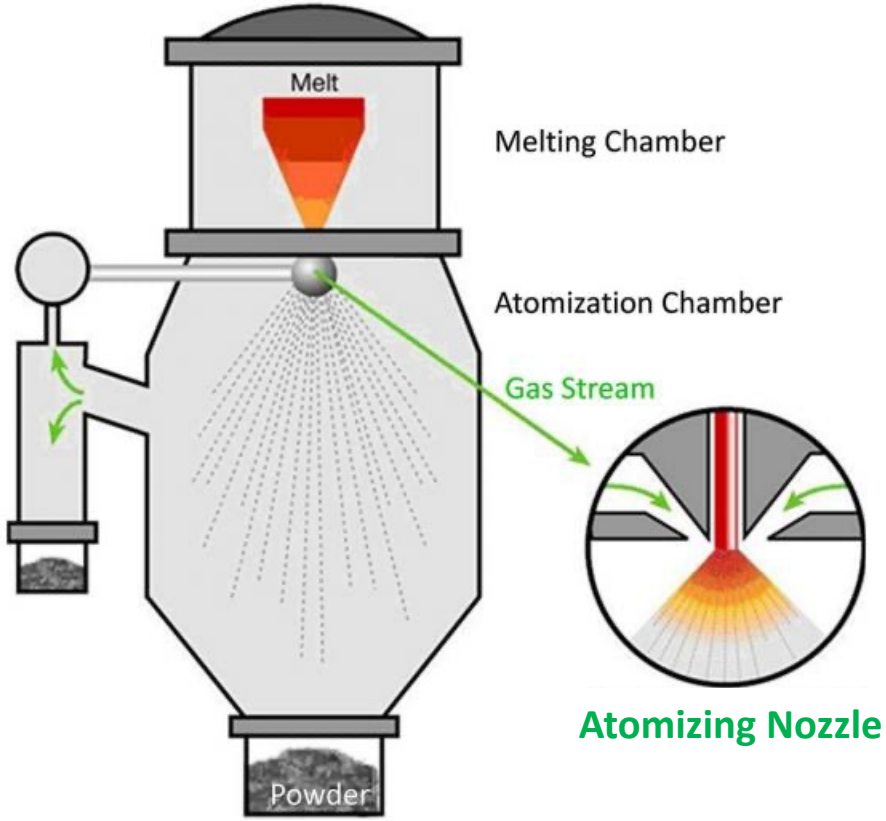
Presentation Outline

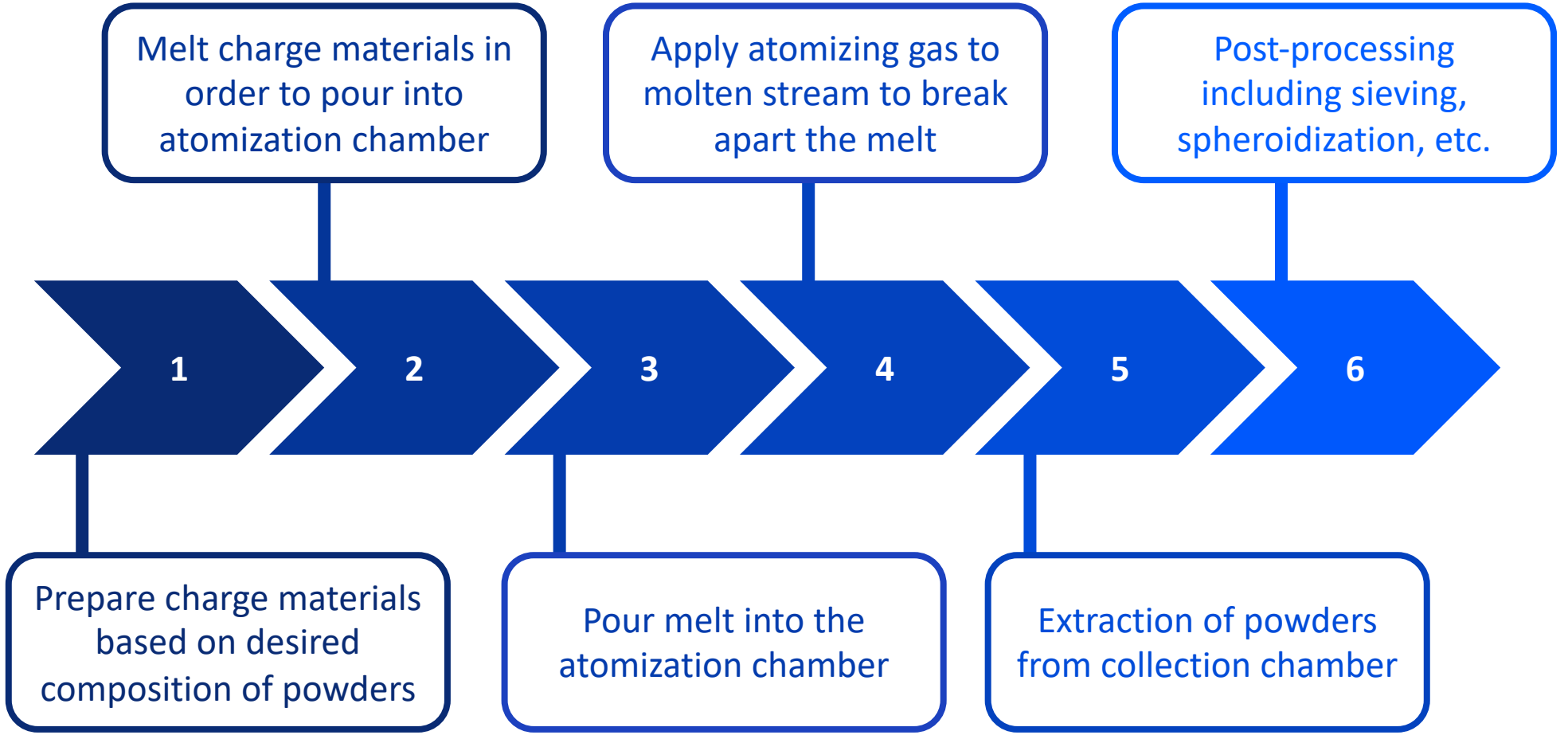
- What is Gas Atomization?
- Gas Atomization Process
- Applications of Gas Atomization
- Capabilities at University of Central Florida
  - ✓ Gas Atomization System at UCF
  - ✓ Gas Atomization Parameters
  - ✓ Gas Atomized Powders
  - ✓ SLM Builds from As-Atomized Powders
- Summary

What is Gas Atomization?

- Gas atomization is the process where the liquid metal is disrupted by a high-velocity gas such as air, nitrogen, argon or helium.
- Occurs by kinetic energy transfer from the atomizing medium to the metal.
- Many different configurations of gas atomizing systems, we will focus on vertical, free-fall gas atomizers.
- Results in the production of metallic powders which can be used in powder metallurgy.

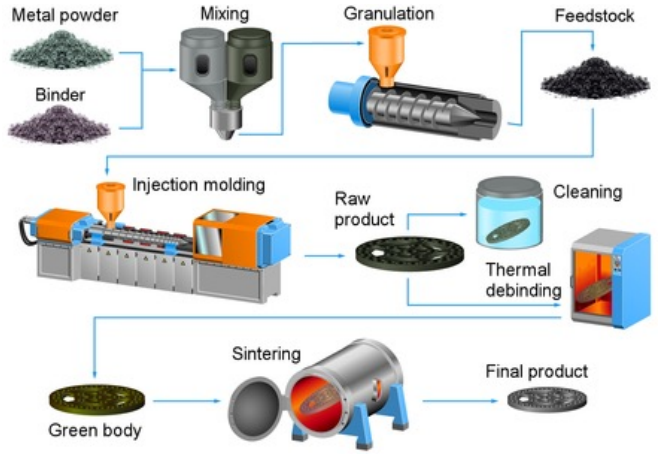


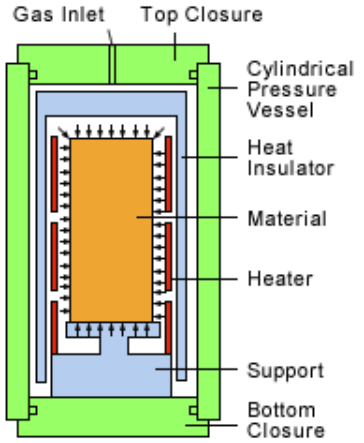
Gas Atomization Process

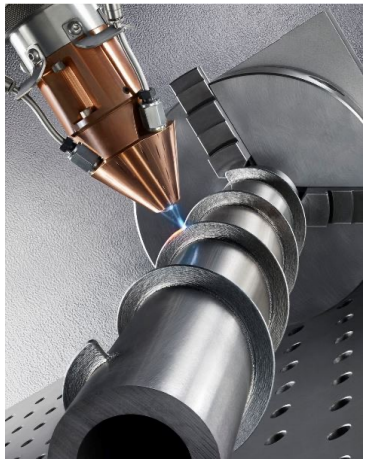


Applications of Gas Atomization

- Gas atomization can theoretically be conducted on any metals which have:
  - ✓ Melt temperatures below 1800˚C
  - ✓ Relatively low viscosity
- Therefore, gas atomized powders can be used in powder metallurgy applications:
  - ✓ Metal Injection Molding
  - ✓ Powder Forging
  - ✓ Hot Isostatic Pressing
  - ✓ *Metal Additive Manufacturing*







University of Central Florida | Sohn Lab

SLM Solutions
SLM 125HL

Max. Build Volume
5” x 5” x 5”

Laser Type
Yb Single Fiber

Max. Laser Power
400 W

Dongyang Inc.
Gas Atomization System

Max. Temperature
1800˚C

Max. Gas Pressure
4 MPa

Atomizing Gas Types
Argon, Nitrogen

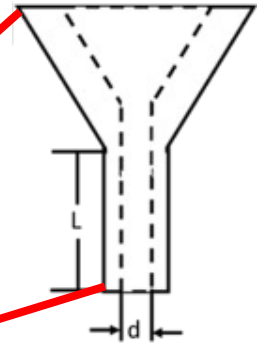
University of Central Florida, Orlando, FL
Professor Yongho Sohn

Gas Atomization in Action

1. Conduct gas atomization run after preparing and melting charge materials/alloys.
2. Open atomization chamber and sweep powders down into the extraction column.
3. Collect atomized powders from collection chamber.

Gas Atomization Parameters

Orifice "Funnel" Geometry



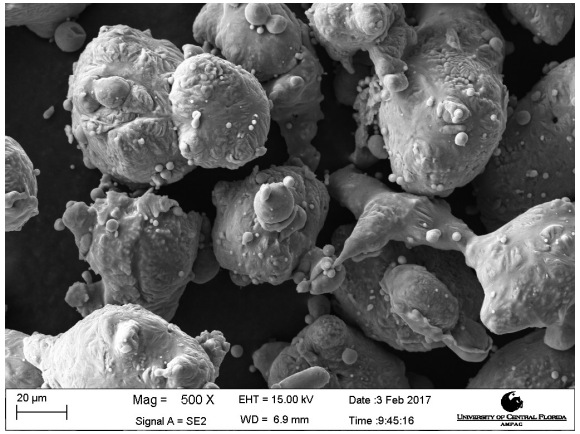
Funnel diameter affects the melt flow rate and melt/gas interaction

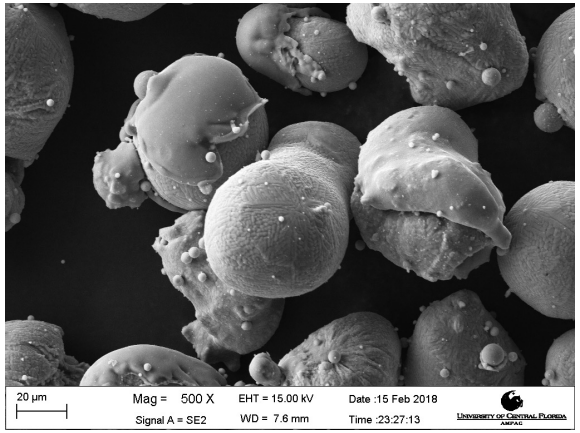
Atomizing Gas Pressure

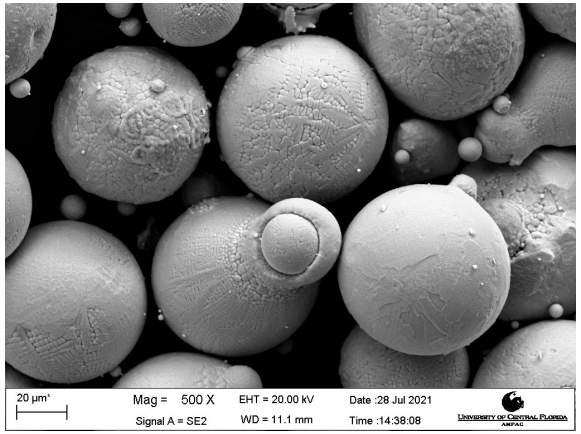
Melting Temperature

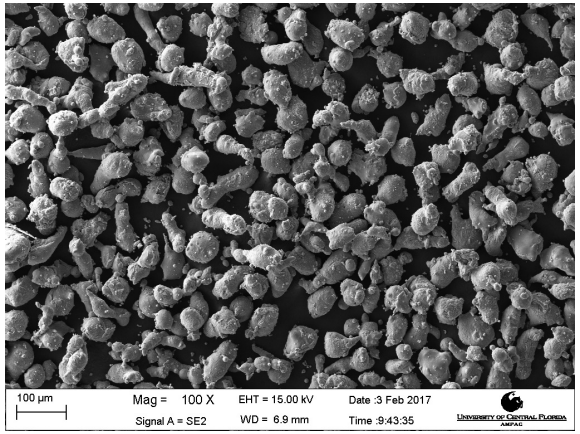
$$\text{melt flow rate} = \frac{\text{charge weight (kg)}}{\text{duration of atomization (s)}}$$

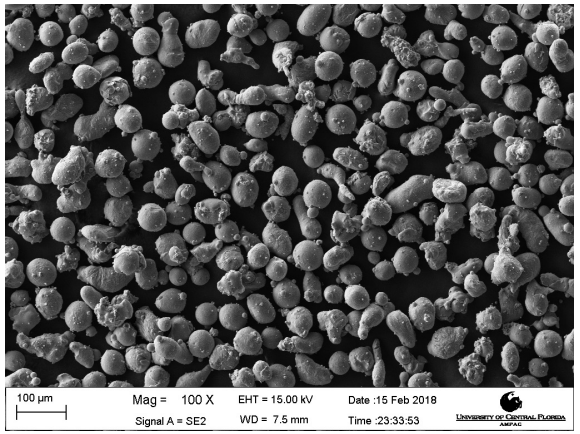
Gas Atomized Powders

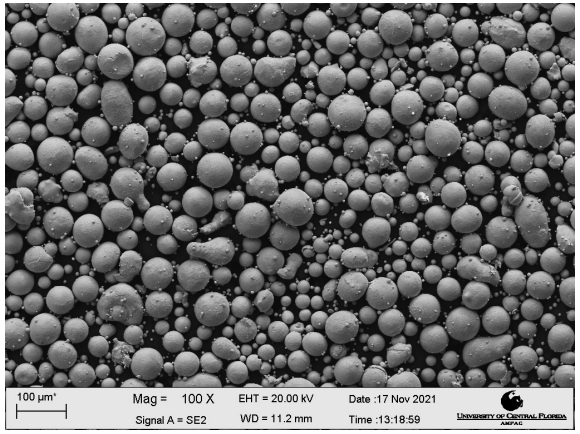






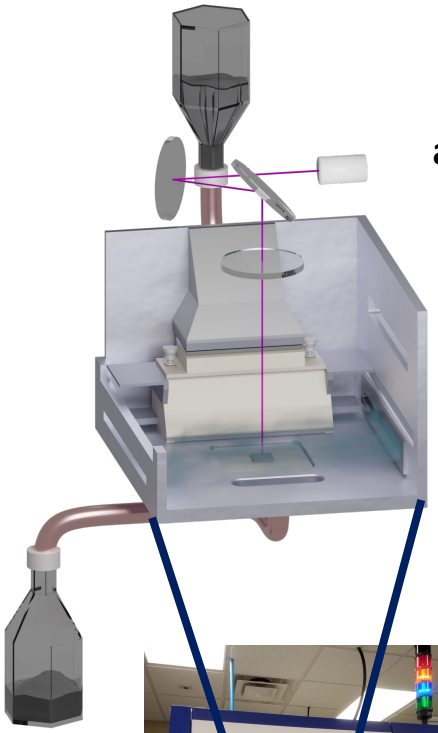






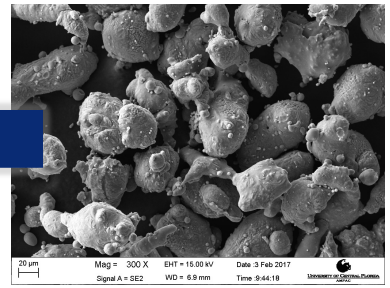
Al10SiMg Powders **AlZnMgScZr Powders** **Ultrahigh C Steel Powders**

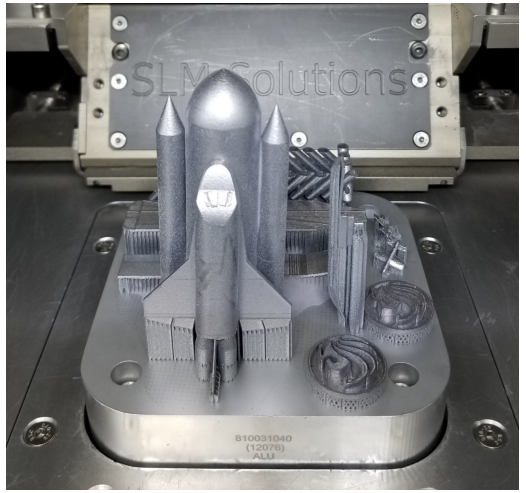
SLM Builds from As-Atomized Powders

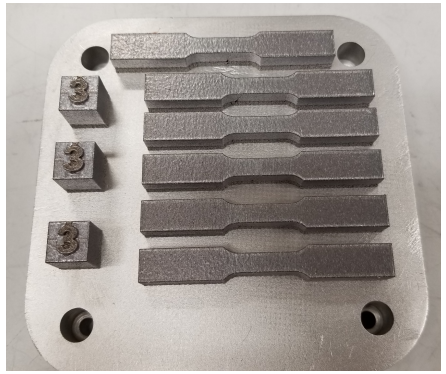


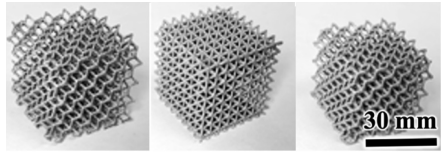
Full Scale Manufacturing Process

From charge material, to powders to additively manufactured components.









Summary

- Gas atomization is process in which a liquid metal stream is disrupted by a high velocity gas to produce relatively spherical metal powders.
- The gas atomization process involves melting of a charge alloy, pouring molten metal stream into a gas chamber, high pressure gas flows to break apart the melt, and collection of metallic powders.
- The Sohn laboratory at the University of Central Florida has unique gas atomization and selective laser melting capabilities that are used to fuel full-scale additive manufacturing research.
- Gas atomized metallic powders are used in many powder metallurgy applications, the most promising of which being additive manufacturing.

If you're interested in learning more: https://stars.library.ucf.edu/etd2020/267/