



**Óbuda University, Doctoral School on Material Science and  
Technology.**

# **Testing in Semi-Solid State**

**PhD Student**

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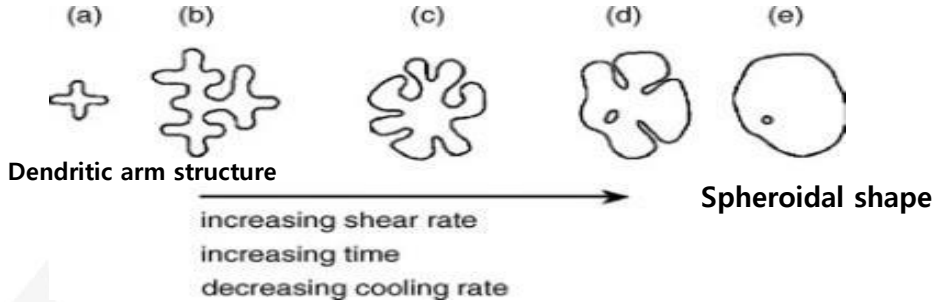
# Outline

- ✓ **Background**
- ✓ **Al-Cu cast alloy**
- ✓ **Why Semi-solid ?**
- ✓ **Process window**
- ✓ **The feedstocks**
- ✓ **Results and Analysis**
- ✓ **Results of the actual semester**
- ✓ **Activity in this semester**
- ✓ **Future research plan**

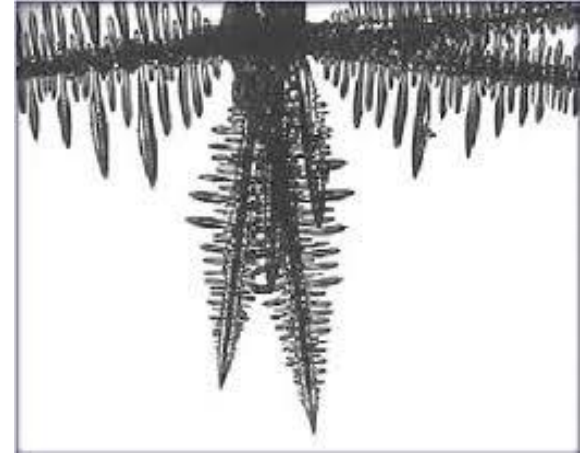


# Background

## Microstructural changes



( a, b and c) The shear stresses change the shape of the solid particles from dendritic (d and e) to globular



Dendritic Structure of material

## Semi - Solid Metal Processing?

- ❖ Near Net-shapes/thick and thin walls
- ❖ Heat treatable
- ❖ Weldable
- ❖ High Mechanical and functional performance

**What is Semi - Solid State?**

# Al-Cu cast alloy

Aluminum Series A201

| Source (wt%) | Al   | Cu  | Ag   | Mn   | Mg   | Si   | Fe   | Ti   |
|--------------|------|-----|------|------|------|------|------|------|
| Experiment   | Bal. | 4.7 | 0.59 | 0.31 | 0.28 | 0.10 | 0.05 | 0.21 |

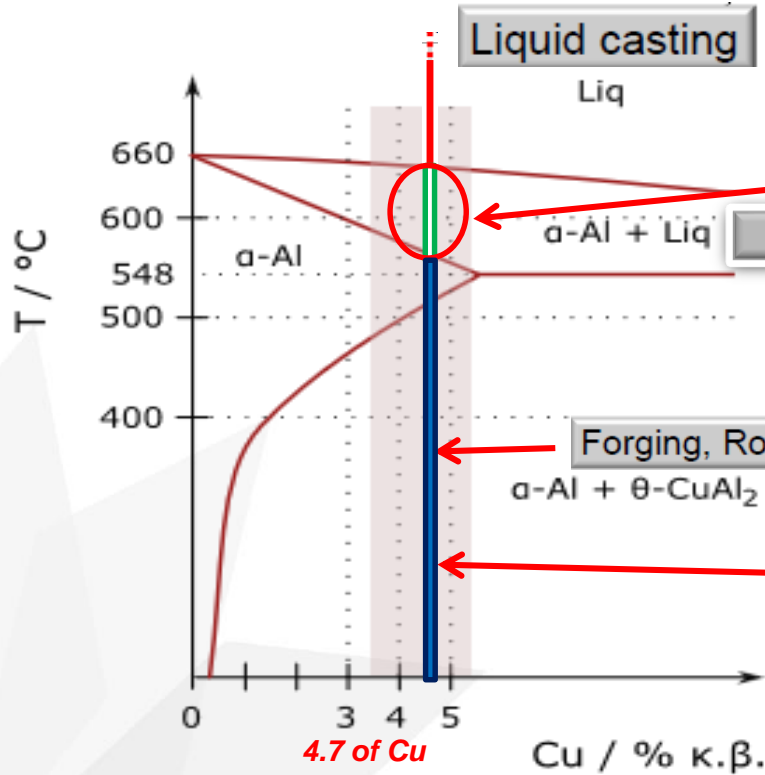
## Advantages:

- High mechanical properties,
- Good formability,
- Excellent machinability
- Good corrosion resistance

## Application:

- Components in military aircraft
- Missiles and impellers for gas turbines

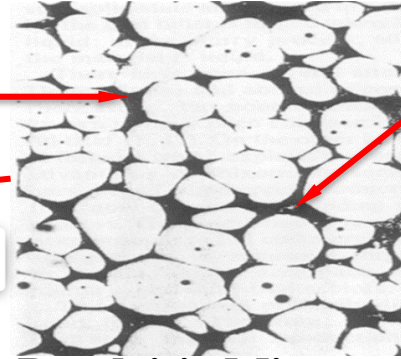
# Semi-Solid Process Window



Al Cu Phase diagram

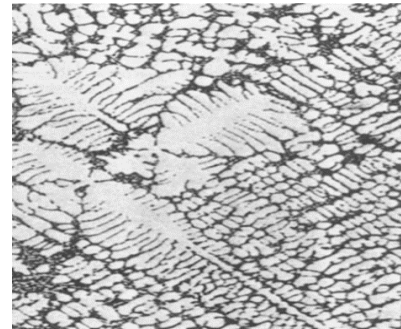
Spheroidal solid

Liquid



Non-Dendritic Microstructures

Spheroidal microstructure



Dendritic stature

Dendritic Microstructure

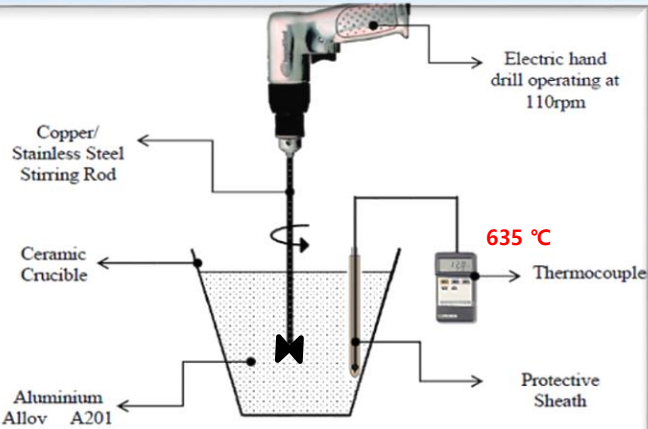
How can get Semi - Solid State?

# The feedstock

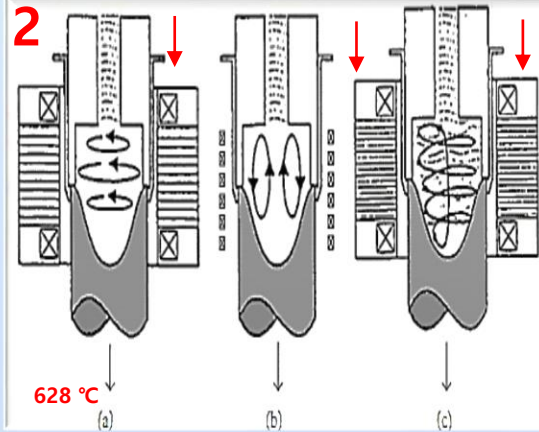


1. Semi-Solid Rheocasting (SSR) process
2. Magneto Hydrodynamic (MHD) Method
3. Cooling Slope Method
4. SSR with CS techniques

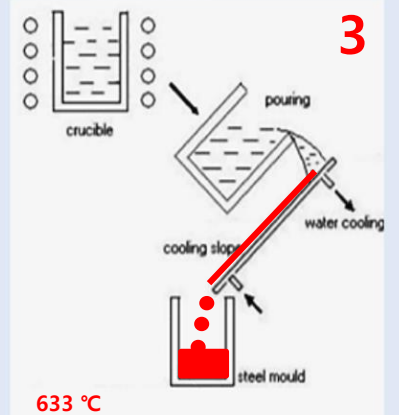
1



2



3



4

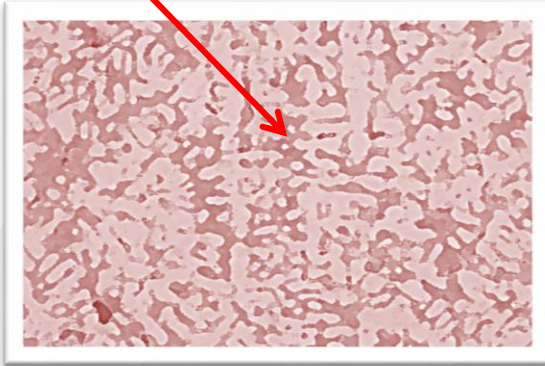
636 °C



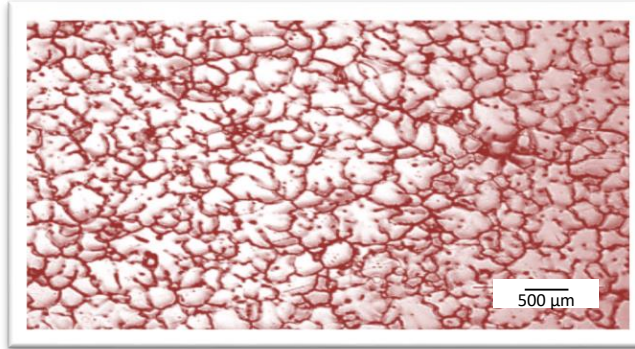
# Results and Analysis

## Microstructure of Aluminum Alloys A201 feedstocks

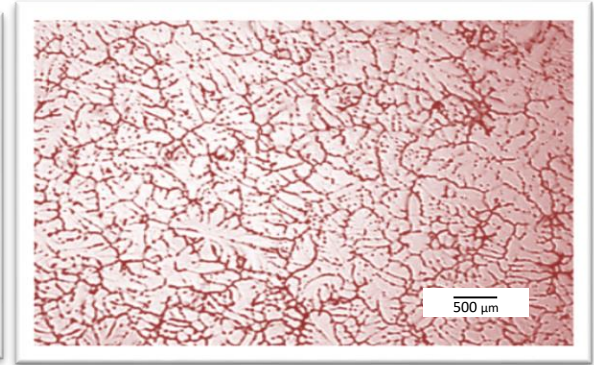
Dendritic stature



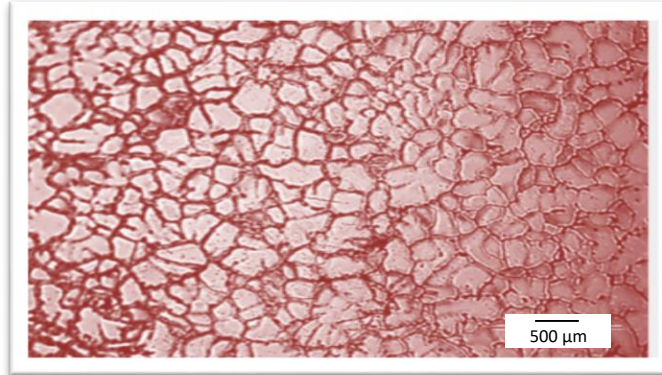
Dendritic Microstructure



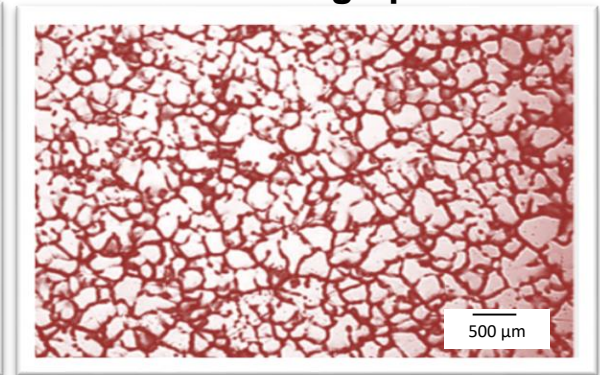
CS Micrograph



MHD Micrograph



SSR Micrograph



SSR + CS Micrograph

# Results and Analysis

| No. | Samples  | Shape Factor | Grain Size $\mu\text{m}$ |
|-----|--|--------------|--------------------------|
| 1.  | Semi-Solid Rheocasting SSR                       | 0.670        | 46.95                    |
| 2.  | Cooling Slope CS                                 | 0.705        | 39.64                    |
| 3.  | Semi-Solid Rheocasting with Cooling Slope SSR+CS | 0.735        | 38.32                    |
| 4.  | Magneto-Hydrodynamic MHD                         | 0.385        | 25.85                    |

**Table (1)** Shape Factor and Grain size of variance types of Alloy A201





# Results of the Actual semester

## 1. Materials Investigations II three Parts:

- I. Physical Adsorption by Ph.D. Szilvia Klébert
- II. Field portable XRF analysis (PXRF) by Dr. Zoltan MAY
- III. X-ray Photoelectron Spectroscopy (XRS) by Dr. Miklos MOHAI

## 2. **Plasticity** by Dr. Ruzinkó Endre

# Activity in this Semester

## ✓ **Conference and Publications paper :**

Participated in IESB 2017 conference my topic was (Comparison of the techniques to produce non dendritic feedstocks for thixoforming) in (2017.11.27)

## ✓ **Supervising Exam.**

## ✓ **Lecture.**

## ✓ **Laboratories work.**

## ✓ **Visit Galleries:**

- International Engineering Symposium
- Automotive Hungary
- Program of modern technologies and associations

# Future Research Plan

- My Future Study will be about **behavior aluminum in high temperature.**

Work will be about mechanical properties such as **ductility** and **strength**.

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**Thank you.....**