Growth velocity and thermophysical properties of materials using Electromagnetic Levitation

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Introduction

- Engineering degree at Ecole des Mines de Nancy – France
  Major in Energy, Environment & Process Engineering

- Phd in Materials Engineering at the University of Alberta – Canada

- 3rd year PhD candidate working on the measurement of material thermophysical properties
Our research under microgravity

• Electromagnetic levitation to study solidification and thermophysical properties of materials

• Dendritic growth velocity and microstructure

• Density, surface tension, and viscosity
ElectroMagnetic Levitation (EML)

- Direct observation of solidification
- Forced convection (~ 0.3 m/s*)
  → Influence on heat and mass transport

  J. Lee et al., Met. Mat. Trans. B (2014)
Oscillating drop experiments $\text{Al}_{89}\text{Cu}_{11}$
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Microgravity EML

TEMPUS PF campaign, Sept. 2013

30‘000 FPS
Duration: 50 ms

ΔT ≈ 130 K
v ≈ 0.19 m/s
Dendritic front

42‘000 FPS
Duration: 0.6 ms

ΔT ≈ 272 K
v ≈ 8.4 m/s
Spherical front
Growth velocity for D2 tool steel

- Microgravity data fits with ground-based experiment
- No observed effect of convection on growth velocity
- Change of the growth front morphology observed above $\Delta T_{hyp} \approx 264$ K
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