Comparison of Structure and Segregation in Alloys Directionally Solidified in Terrestrial and Microgravity Environments (CSS)

Microstructure Formation in Castings of Technical Alloys under Diffusive and Magnetically-Controlled Convective Conditions (MICAST), and Columnar-Equiaxed Transition in Solidification Processing (CETSOL)

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NASA Objectives and Contributions:

- Defects in directionally solidified dendritic alloys result in production losses. Misalignment of dendrite arms and macrosegregation are produced by uncontrolled convection.
- NASA's interest is in enhancing the mathematical modeling of solidification with global objectives.
- A specific objective is the simulation of solidification in castings of changing cross section.

Relevance/Impact:

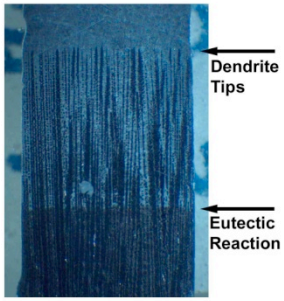
- Many industrial applications involve directional solidification. Convective effects are significant, particularly in today's more complex alloys.
- Reduction of such crippling defects as "freckling" will have a significant effect on production efficiency.

Development Approach:

- The MICAST team will focus on microstructure control during directional solidification, particularly in Al-Si alloys.
- Flight experiments will controllably modify convection during directional solidification both with and without magnetic control.
- Computer simulation will be used to evaluate convective effects and define the thermal and magnetic field boundary conditions.
- CETSOL will investigate pattern formation in castings, particularly the transition from columnar to equiaxed.
- Alloys requiring observation of the solid-liquid interface will be processed in SQF (Solidification and Quench Furnace) insert.

LGF Low Gradient Furnace, MSL – Materials Science Laboratory
MRSS – Materials Science Research Rack

Ground-based Research



"Mushy Zone"

Freckles from macrosegregation

ISS Resource Requirements

Accommodation (carrier)	LGF within MSRR
Upmass (kg) (w/o packing factor)	0.01 for samples 2 for SACAs
Volume (m^3) (w/o packing factor)	10e-8 for samples 0.005 for SACAs
Power (kw) (peak)	TBD
Crew Time (hrs) (installation/operations)	4
Autonomous Operation	TBD
Launch/Increment	TBD

Project Life Cycle Schedule

Milestones	SCR	RDR	PDR	CDR	VRR	Safety	FHA	Launch	Ops	Return	Final Report
Actual/ Baseline	12/98							06/09 17A			