Technical University
of **Leoben**

Science 4 Technology – Poster Exhibition 2026

Department: Metallurgy

Chair: Simulation and Modelling of Metallurgical Processes

BRW
Works Council
of the Scientific Staff

Table of contents

Rheological Measurements on Dense Suspensions Containing Dendrite-like Particles

During alloy solidification, equiaxed dendrites often move within the solidifying liquid, being one of the main causes of macrosegregation, therefore a deeper understanding of this behavior is particularly important. Inspired by rheological investigations with dense suspensions containing spheres, pressure-imposed rheological measurements using an annular shear cell were performed and applied to suspensions containing 3D-printed dendrite-like particles (Fig. 1), also called here OPS6.

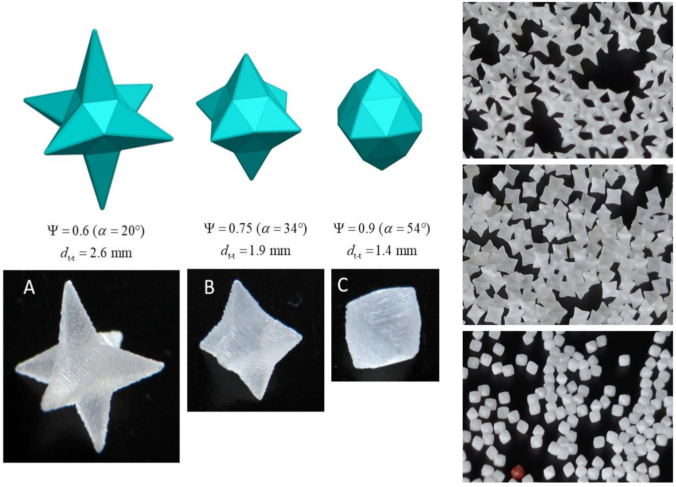


Figure1: CAD models and 3D-printed OSP6 particles with different sphericities ψ, and tip angles α. Although particles A, B, and C differ markedly in their tip-to-tip length, they each encapsulate the same volume.

The viscosity of a dense suspension containing OSP6 particles is higher than that of a suspension containing spherical particles (Fig. 3). Interestingly, OSP6 particles without pronounced side arms, more close to spheres exhibit a higher suspension viscosity than those with long side arms, due to the presence of planar facets, which increase friction as the particles slide along these facets. When pronounced side arms are present, rotation is the predominant mechanism by which particles move past one another, and sliding is less relevant.

Measurements were conducted using a Anton Paar MCR 702 rheometer. For a given solid fraction of a specific particle type in Glycerol or PEG-PPG, and for imposed values of the torque and the normal force, the rotation rate and the cover position were recorded as functions of time (Fig.2).

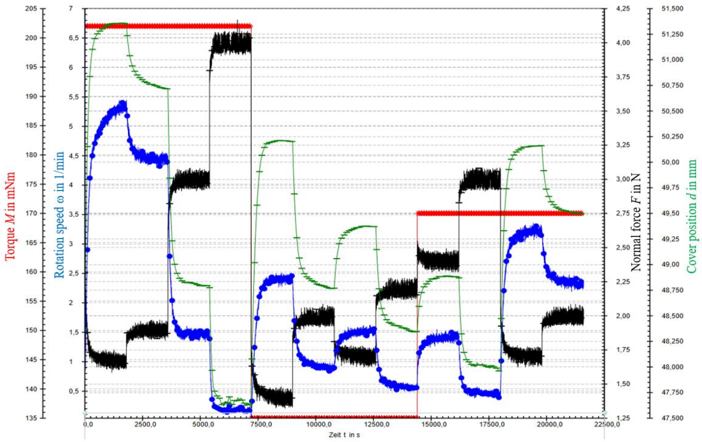


Figure2: Example of twelve measurements, each lasting 1800 s, for A-type particles in PEG-PPG.

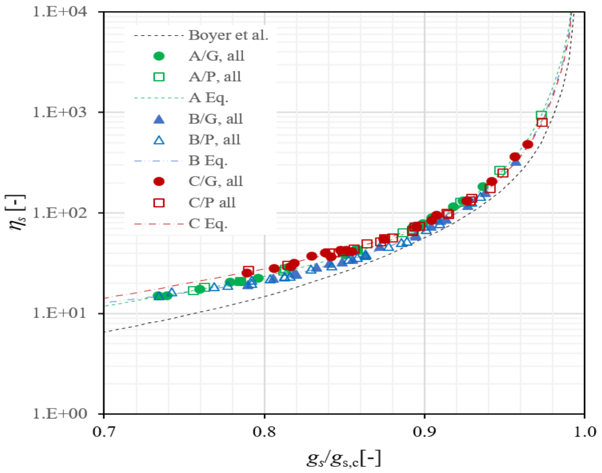


Figure 3: Dimensionless shear viscosity as function of the normalised solid fraction for the different OSP6 particles processed in both glycerol and PEG-PPG.

Dipl. Ing. Dr. mont.
Mihaela Stefan-Kharicha
SMMP
Metallurgie Department
mihaela.stefan-kharicha@unileoben.ac.at

Research focus

- Solidification,
- Crystal growth,
- Particle Image Velocimetry (PIV)
- Rheology
-

SMMP

FWF
Der Wissenschaftsfonds.

Montanuniversität
Leoben

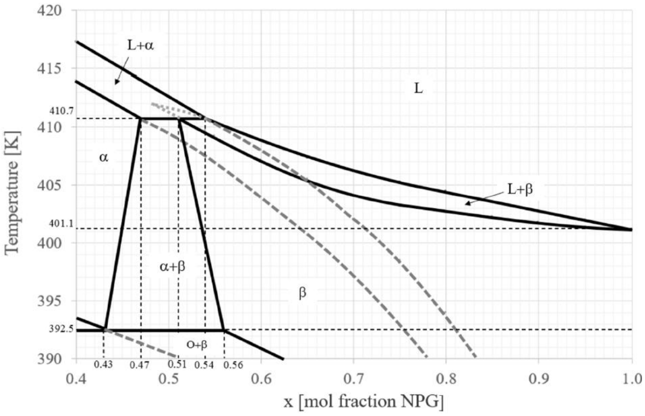
Science 4 Technology @ MUL
Poster Exhibition 2026

Betriebsrat
Wissenschaft

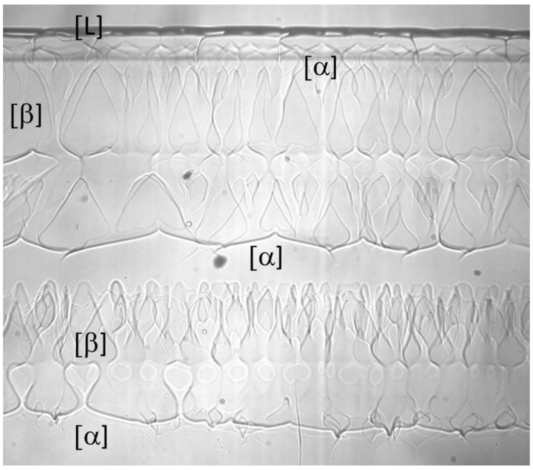
Layered Peritectic Microstructures

Influence of Gravity on Banded and Coupled Growth (1g vs. µg)

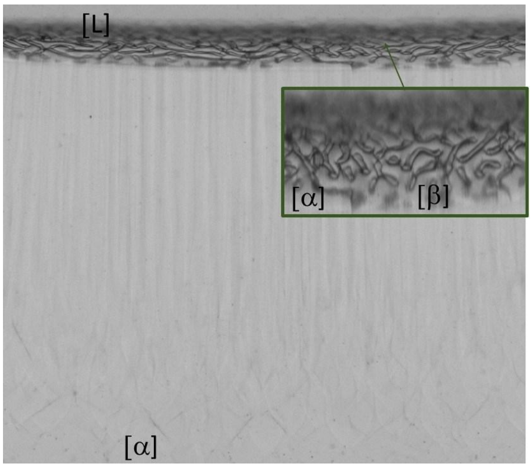
Introduction: During **directional peritectic solidification** (L+α→β), the interaction between solidification (L→β) and the transformation (α→β) governs microstructure formation. Under conditions where both phases can grow with a stable planar interface, **coupled growth**, **banded structures**, or intermediate morphologies may occur. Since such layered structures are highly sensitive to convection ahead of the solidification front experiments where conducted 2021 on board the International Space Station.



Experimental Set-up: The transparent organic model system TRIS–NPG exhibits a peritectic reaction and was therefore used for *in situ* investigations of peritectic solidification [1]. Directional solidification experiments for a concentration x = 0.515 were performed using the Bridgman technique, enabling direct observation of microstructure evolution with a transmitted-light microscope.



Experimental Results: Under terrestrial conditions (1g), competitive growth dominates. Initially, alternating banded structures form, which evolve into coupled growth with a characteristic tulip-like morphology (β-phase). At this stage, neither phase is favored; ultimately, however, only the peritectic phase continues to grow [2].



Under microgravity (µg) conditions, the initially formed banded structure rapidly evolves into competing lamellar growth between the phases, visible as an oscillating zig-zag pattern along the solid–liquid interface, see enlarged section [3].

Conclusion: In-situ observations reveal the dynamic evolution of layered peritectic solidification morphologies under both normal gravity (1g) and microgravity (µg). While convection ahead of the solidification front under 1g significantly alters lamellar morphology, µg conditions enable purely diffusion-controlled transport, allowing direct validation of diffusion-based models and clear identification of convective effects.

[1] A. Ludwig, J.P. Mogeritsch, V.T. Witusiewicz, J Cryst. Growth 604 (2023) 604, 127052
[2] A. Ludwig, J.P. Mogeritsch, T. Pfeifer, Acta Materialia 126 (2017) 329e335
[3] A. Ludwig, J.P. Mogeritsch, Met. Mater. Trans. A 54 (2023) 4179–4187, https://doi.org/10.1007/s11661-023-07052-6

Dipl. Ing. Dr. mont.
Johann P. Mogeritsch
Chair of SMMP
Modeling and Simulation metallurgical Processes
Department Metallurgy
johann.mogeritsch@unileoben.ac.at

- Research focus: Layered peritectic solidification structures
- Research partners esa FFG
- QR-code

SMMP

Move mountains