

# Micro Injection Molding and Material Development

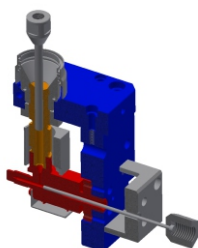


Micro injection molding offers great potential to produce highly sophisticated parts that require a very small amount of material, e.g. parts for medical or electronic devices. The characterization of the material behavior in shaping processes, especially with changing dimensions, is still challenging because of the process-structure-property interactions. Direct correlations to standards have not yet been determined and small-scale specimens have not yet been adequately standardized.

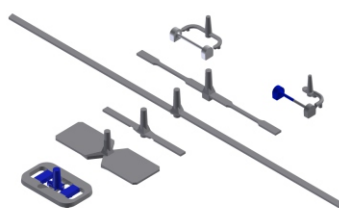
## Micro Injection Molding Specimen

To meet the demands of material development, the IPF has introduced different scaled specimens and testing methods in combination with specialized observation methods. With micro injection molding, very small quantities are sufficient to test the processability of new compounds. Moreover, weld lines and interfaces between different plastics of injection-molded specimens can be investigated even on a microscale.

The plastification system of the microassembly injection molding machine at the IPF uses a preplastification piston and an injection piston. The small volumes allow for plastication through heat conduction without requiring the heat of friction. This makes it possible to process shear sensitive materials in micro injection molding.



Plastification unit (cross section)

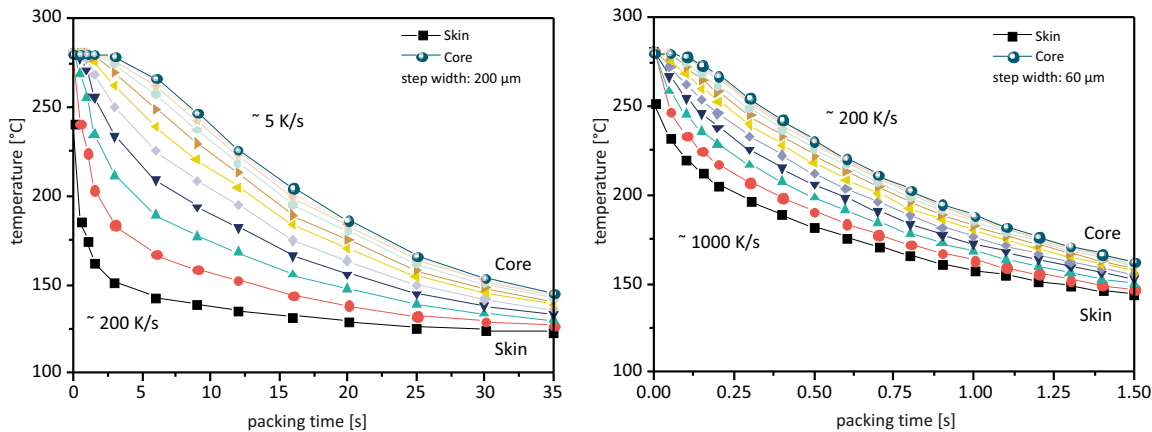


Micro-specimens (selection)



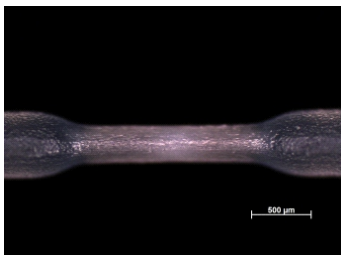
Micro tensile rod on tool insert

For the upscaling of material systems in particular, the different dimensions of test specimens show significant differences in the process conditions, the local stress on the melt and the cooling rates. This results in differences in the crystalline structures, which also reflects in the properties of the specimens and components.

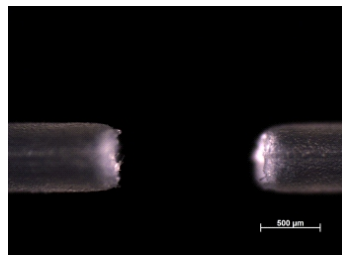


Cooling simulation of the packing phase at the cross section of a weld line, from skin to core, left: CAMPUS 1A tensile bar, 4 x 10 mm (PBT); right: micro tensile rod, ø = 0,6 mm (PBT)

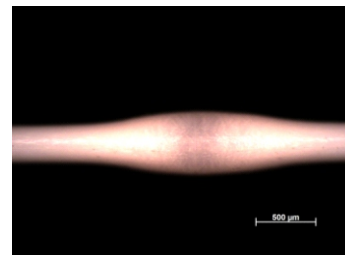
Due to the holistic analysis of the manufacturing process and the material systems used, efficient material development can be implemented at the IPF by means of micro injection molding. With the support of experimental designs (DoE) and process simulations, morphological structures and mechanical properties can be correlated and used for upscaling and micro-components can be optimized.



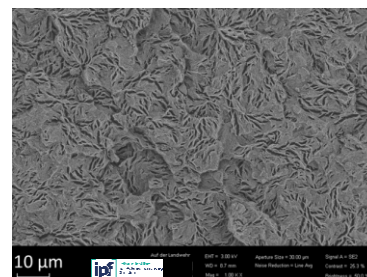
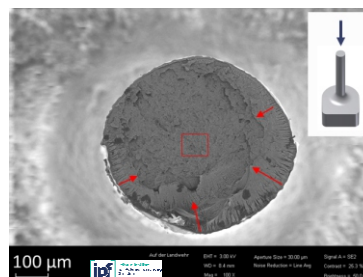
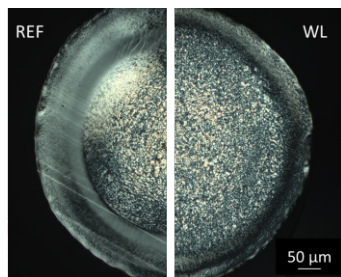
Necking at a weld-line



Brittle fracture at a weld-line (glass-fibre reinforced)



Necking out of a weld-line



Left: Morphologies resulting from different processing conditions (thin section 10 µm); Fractographic analysis at the weld line (SEM, middle) and details (right)

## Contact

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## Literature

1. M. Fischer, P. Pöhlmann, I. Kuehnert, Morphology and Mechanical Properties of Micro Injection Molded Polyoxymethylene Tensile Rods. *Polymer Testing* 80, (2019)
2. Fischer, M., Ausias, G., Kuehnert, I., Investigation of interfacial fracture behavior on injection mold-ed parts. AIP Conference Proceedings (2016) 1713: pg. 040011.
3. Kuehnert, I., Fischer, M., Ausias, G., Influence of Interfaces/Weld Lines on Fracture Behavior of Polypropylene Specimen Related to Material Properties, ANTEC, Las Vegas (NV), USA (2014)