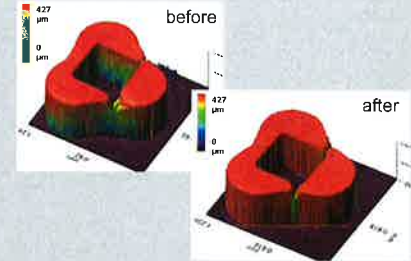
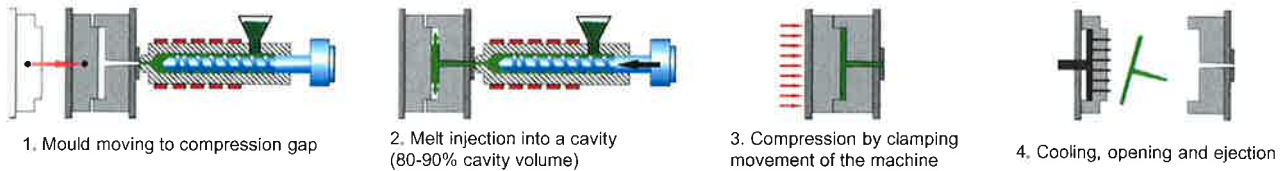


## Summary

- Successful implementation of the simultaneous micro injection compression moulding for powder materials (using the example of zirconium feedstock)
- First significant process parameters were determined
- Obvious improvement of the replication of micro structure, especially near to the gate
- Micro structure with high quality potential by powder injection compression moulding



## Process cycle of simultaneous Injection Compression Moulding



## Performing of simultaneous micro powder injection compression moulding ( $\mu$ -PICM)

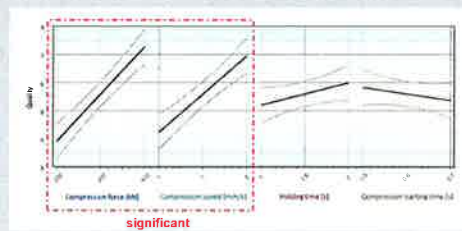
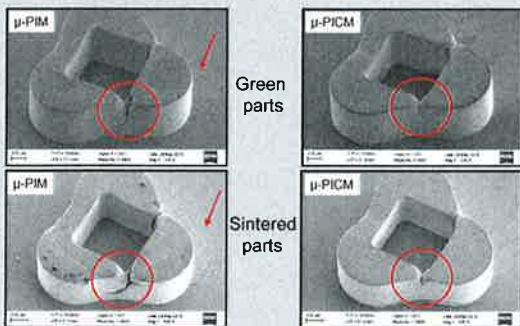
- Mould with shearing edges
- Commercial injection moulding machine (ARBURG® Allrounder 420C)
- Design of Experiments (DoE): full two-level four-factorial ( $2^4$ )

- Investigation of replication quality especially in the area with micro structures of high aspect ratio
- Qualitative rating by use of binary evaluation and arithmetic average of each structure
- Influence of the position of micro structure (near and far to the gate)

Process parameter	Low level	High level
Compression force [kN]	200	400
Compression speed [mm/s]	1	3
Compression starting time [s] after injection of feedstock	0.5	0.7
Holding time [s]	1	2



## Reproduction results of micro structure & conclusions



- quality of the micro structures advanced **significantly** with increasing **compression force and compression speed**
- holding time of the compression force with small influence

- **clear improvement of the replication** by  $\mu$ -PICM could be detected near to the gate
- reasons for worse replication near to the gate at  $\mu$ -PIM: structure in shadow position to flow direction of feedstock and cool down of feedstock
- wrinkle in the bottom of the structure as a result of compression process of already cooling feedstock at  $\mu$ -PIM
- sintered parts: crack in unfilled area at injection moulded micro structure grew at necessary heat treatment

- starting time of the compression: uninvited effect on the structure quality  $\rightarrow$  freezing of the feedstock especially near to the gate at later starting of the compression step cause unfilled micro structure



- **filling of the structure** in selected areas is considerably **superior** with **micro powder injection compression moulding ( $\mu$ -PICM)**

- replication accuracy of one selected area at  $\mu$ -PICM minor declines with distance to the gate