Road to Reliability-
Quality Improvements in Powder Injection Molding

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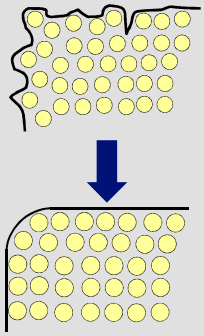
Mechanical Properties

Concept

Improving mechanical properties by influencing the base material:

- Binder composition
- Powder loading

Curing of defects at the surface of the specimen by adjusting of post-treatment (debinding and sintering):

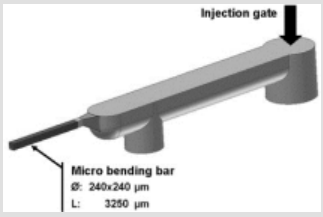


Experiments

Variation of binder composition of ZrO_2-feedstocks by:

- Additiv type
- Additiv content
- Polymer : wax ratio

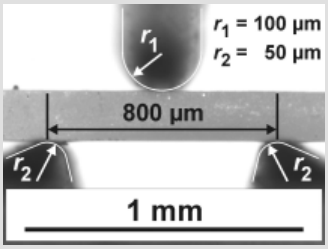
Fabrication of micro-bending specimen:



Post-processing by either:

- Chemical and thermal debinding
- Only thermal debinding

Measuring of flexural strength



Introduction

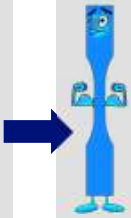
PIM as a fast growing, high output productions methods still faces challenges in maintaining high quality products regarding

- Reproducability
- Mechanical behaviour

This work is focussing on the investigation on the influence of production parameters as well as material compositions on these properties.

Results

Table 1: Comparison of flexural strength of ZrO2 in "As fired" state



Literature [L] vs. Study [S]	Flexural strength
Mean value [L]	≈ 900 GPa
Mean value [S]	≈ 1800 GPa
Max. value [S]	≈ 3000 GPa

→ Smoothing of low profile surface defects without noteworthy rounding of edges (r = 0.1 – 0.5 µm)

Results

High accuracies achieved for both metal and ceramic parts:

Table 2: Comparison of standard deviations of powder injection molded parts (literature vs. experiments)

Material	Literature [1]	Experiment
17-4PH	± 0.3 %	± 0.06 %
ZrO_2	± 0.1 %	± 0.05 %

Conclusion

Both dimensional accuracy and specimen strength were increased by conducted methods. A thorough selection of molding parameters as well as feedstock/binder composition is crucial for high quality PIM.

Dimensional stability

Concept

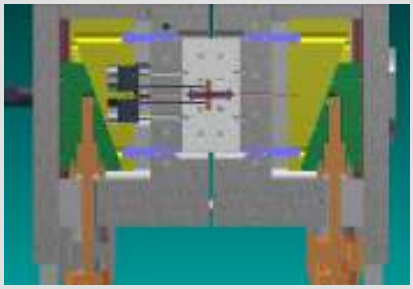
Investigation of

- Molding parameters
- Feedstock composition

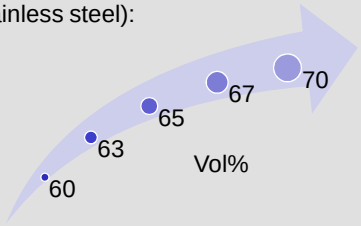
and their influence on the dimensional stability and repeatability in PIM.

Experiments

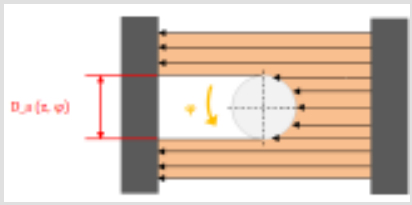
I) Variation of parameters using special tool design with two moving pistons (Ceramic feedstock):

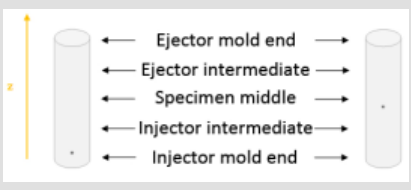


II) Variation of powder loading (stainless steel):



Measurement of diameter (cylindrical specimen) using laser micrometer





Acknowledgements

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References

[1] R.M. German, Metal Injection Molding: A Comprehensive MIM Design Guide, 2011