**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 ZrO₂-feedstocks by:
- Additive type
- Additive content
- Polymer : wax ratio

Fabrication of micro-bending specimen:

Post-processing by either:
- Chemical and thermal debinding
- Only thermal debinding

Measuring of flexural strength

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### 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**

<table>
<thead>
<tr>
<th>Material</th>
<th>Literature [L] vs. Study [S]</th>
<th>Flexural strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean value [L]</td>
<td>≈ 900 GPa</td>
<td>Mean value [S]</td>
</tr>
<tr>
<td>Max. value [S]</td>
<td>≈ 3000 GPa</td>
<td></td>
</tr>
</tbody>
</table>

→ Smoothing of low profile surface defects without noteworthy rounding of edges ($r = 0.1 – 0.5 \, \mu m$)

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

<table>
<thead>
<tr>
<th>Material</th>
<th>Literature [L]</th>
<th>Experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-4PH</td>
<td>± 0.3 %</td>
<td>± 0.06 %</td>
</tr>
<tr>
<td>ZrO₂</td>
<td>± 0.1 %</td>
<td>± 0.05 %</td>
</tr>
</tbody>
</table>

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### 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.

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### References