Injection Moulding

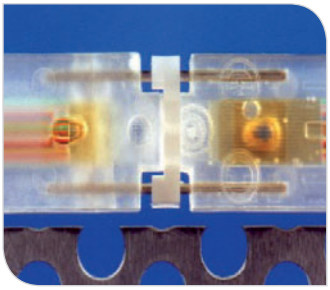
Short technology description
Injection moulding allows the low cost mass fabrication of large microstructured as well as singular micro parts using prestructured mould inserts as master. In both cases very high geometric accuracies and smallest tolerances can be achieved using e.g. LIGA fabricated mould inserts. Besides the replication of polymers powder injection moulding (MicroPIM) is under development for the microfabrication of components made of a large variety of metals or ceramics. Two-component injection moulding reveals strong advantages with respect to reduced mounting expenditures and the capability to produce multi-functional devices.

Special features
- Cycle times < 5 s–6 min
- Largest replicated aspect ratio:
  – 17 for free standing structure (height: 2000 µm; width: 115 µm)
  – 25 for buried structure (height: 250 µm; width: 10 µm)
- Smallest replicated structural detail < 200 nm for AR=1, in case of lower AR replication minima decrease correspondingly
- Special variants like insert injection mould, compression injection moulding, and inmould-labelling (under development)
- Fabrication of metal and ceramic parts via powder injection moulding under development

Limitations/constrains
- Relatively large efforts for tooling necessary
- Replication process very sensitive to mould insert's surface roughness
- Side wall draft angle or ejector slope is recommended for larger aspect ratios depending on the mould insert's roughness
- Limited undercuts
- No hollow parts in one step fabrication possible

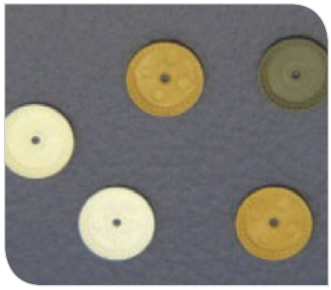
Design rules
- 1- and 2-component injection moulding with polymers on advanced level, PIM for metal and ceramic parts usually requires development efforts
- Polymers: nearly all thermoplastics and thermoplastic elastomers
- Metals: PM steels like 17-4PH and 316L, Cu, W and W-alloys, hard metals
- Ceramics: oxide ceramics like ZrO_2 and Al_2O_3, Si_3N_4, mixture ceramics like TiN-Al_2O_3 with defined electrical conductivity

Typical structures and designs

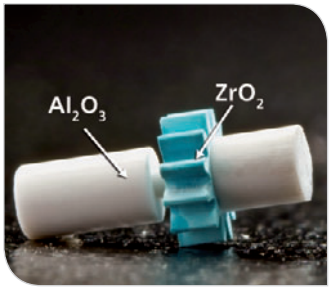


PMMA 16 multifiber connector for multimode application

Prism demonstrators made of different transparent thermoplastics (PMMA, PMMI, PC) including composites filled with nanoparticles



Injection moulded ZrO_2 (white), Cu (brown) and steel (grey) micro gear wheel housings



Combined gear wheel/shaft sample made by two-component injection moulding of alumina (shaft) and zirconia ceramic (gear wheel)

INFORMATION

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Technology
Injection Moulding

Replication

Manufacturing/Fabrication

Material class

Silicon	Polymer	Metal	Ceramic
X	X	X	X

Glass	Organic	Other