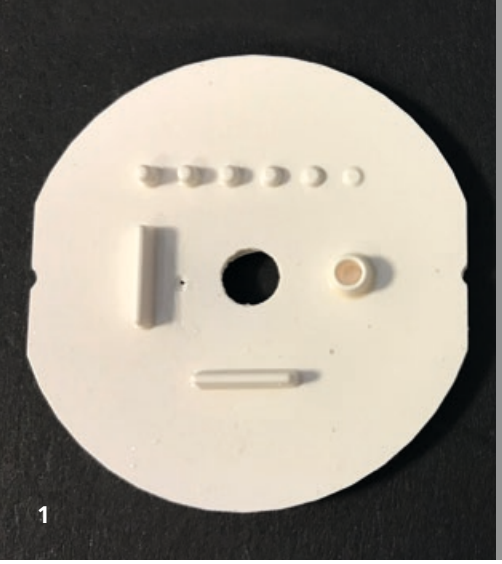

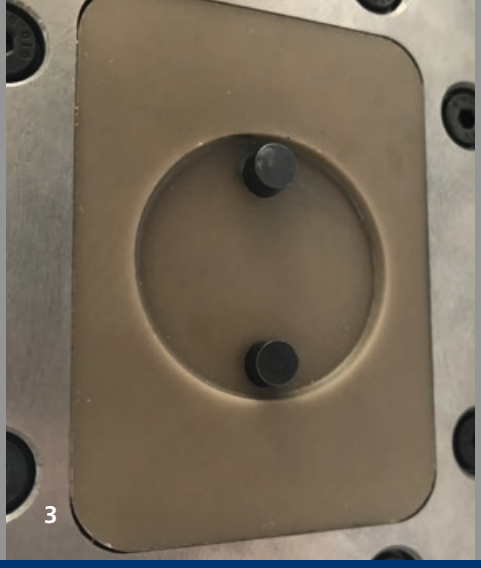

CERAMIC MOLD INSERTS FOR INJECTION MOLDING

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Injection molding technology is widely established for the processing of plastic materials, since it is a resource- and time-saving way of manufacturing complex shaped parts. It is a basic technology implemented in many branches of industry. Due to its high tool costs, however, this technology becomes unprofitable as product designs change more frequently and lot sizes decrease. At Fraunhofer IKTS, an R&D project pursues the development of a novel approach to cost-efficient molding tools for the injection molding of small series up to 10,000 parts. The project shows that thin-walled, precise and wear-resistant mold inserts made of ceramics or ceramic-like composites are a cost-effective alternative to traditional metal designs.

The mold inserts joined with a supporting rear structure needed to be integrated into an existing mold base, together with other tooling components, such as ejector pins. Based on a three-level approach (basic design investigation – investigation of shape complexity – manufacturing of demonstrators) for the development and characterization of test parts, mold inserts were produced from different materials, such as alumina, ZTA, SiSiC and composites with a polysiloxane matrix. This process used various manufacturing techniques, including liquid ceramic manufacturing (LCM), ceramic slip casting, binder jetting and molding from a prototype. First investigations of injection molding with thermoplastics (e.g. with fiber filling, melt temperatures up to 320 °C, injection pressures up to 1200 bar), thermoset composites (tool temperature up to 200 °C) and ceramic feedstocks yielded series productions with up to 1000 parts. These production volumes can easily be expanded to up to 10,000 parts. After completion of the R&D project, the research should result in a decision matrix that enables manufacturers to select suitable fabrication processes and material systems for specific tasks and for the respective injection molding material.

In comparison: Injection molding tools with ceramic or composite mold inserts compared with conventional metal tools

	Design		Mold insert production		Tool integration
Metal mold	Design data	▶	Machining	▶	Complete construction
			Duration 4–5 weeks		Duration 3–4 weeks
Ceramic mold	Design data	▶	Primary shaping/ sintering Image 1	▶	Support manufacturing/tool integration
			Duration 1–2 weeks		Duration 1–2 Days
Composite mold	Prototype	▶	Warm pressing or pouring/ cross-linking Image 2	▶	Support manufacturing/tool integration Image 3
			Duration 1–2 days		Duration 1–2 days

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1 *Mold insert with complex test structure (alumina, LCM).*
2 *Mold inserts made of Al_2O_3 (top), composite (center) and SiSiC (bottom) with substructure.*
3 *Mold insert (composite) with ejector pins mounted in base mold.*

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