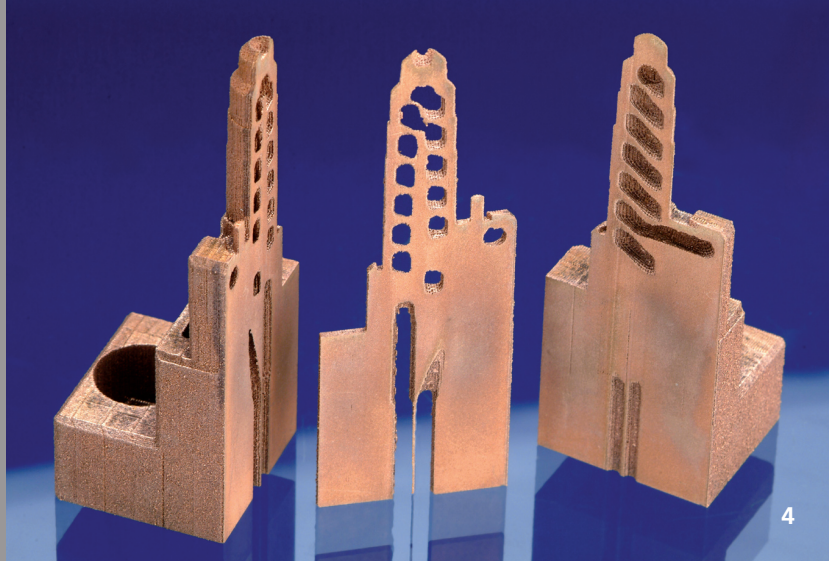




ADDITIVE MANUFACTURING OF COPPER COMPONENTS

Task

Modern injection molding tools are made of various materials in order to minimize cycle times and warping of the plastic parts. Wear- and heat-resistant steels are used, as well as copper-based alloys, which possess high thermal conductivity. To achieve more-efficient process control, tool inserts with conformal cooling are also used at temperature-critical points. Such tool inserts are produced by means of additive techniques such as Selective Laser Melting (SLM). Up to now, tool steels such as 1.2343 and 1.2709 have been used for this. Tool inserts offering more-efficient cooling could be made by combining the high thermal conductivity of copper alloys with conformal cooling channels. The aim is therefore to produce such components from copper alloys using SLM.

Method

Because, in addition to their high thermal conductivity, copper alloys have a lower laser absorption coefficient than e.g. steel, their processing requires higher laser power than that employed for the materials mentioned above, whose processability is already state of the art. At the Fraunhofer ILT, a laser system with a maximum laser output of 1000 W was integrated in an existing SLM installation by adapting the optical, mechanical and control systems. To this end, the process parameters for the additive manufacturing of components with a density of approx. 99.9 percent are being developed in the Innosurface project, which is funded by the German Federal Ministry of Economics and Technology (BMWI). In a further step these results are transferred to complex geometries.

Result

Components made of copper alloys with approx. 99.9 percent density have been successfully produced without any defects using the modified equipment. In addition, the first tool inserts with internally located cooling structures have been manufactured using the additive process (Fig. 3 and 4). These are currently being tested in industrial applications.

Applications

Apart from the tool inserts described above, further areas of application exist where heat needs to be effectively removed, e.g. for cooling semiconductor components.

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3 Tool insert made out of copper alloy produced by means of SLM.
4 Section through a tool insert with integrated cooling channel.

Subject to alterations in specifications and other technical information. 06/2010.