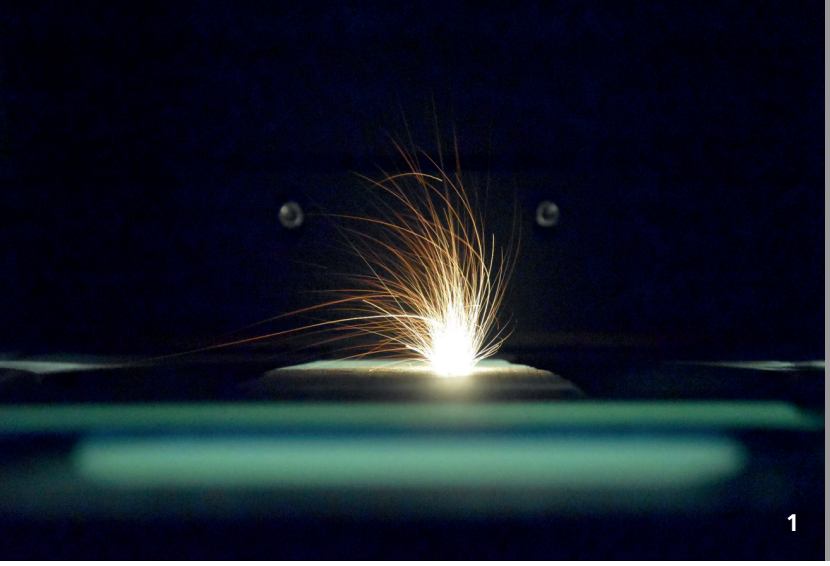

PROCESSING HIGH CARBON STEELS BY SELECTIVE LASER MELTING (SLM)

Task

The additive manufacturing process Selective Laser Melting (SLM), also known as laser beam melting or Laser Powder Bed Fusion (LPBF), is already being used in many industrial sectors, such as turbomachinery and automotive engineering, for a wide range of applications. In mechanical and plant engineering as well as toolmaking, wear-resistant steel materials with high hardness are often required, but these steels are considered to be only partially weldable, which is why processing with SLM leads to cracking. Rolling bearings, in particular, require a higher material hardness in order to achieve a long service life. The goal of the project »NeuGenWälz« is to develop a material with a higher carbon content (> 1 wt.-%), which fulfills the requirements of high hardness and can be processed by SLM.

Method

The local melting and solidification during the SLM process causes cracks in the material. So that steels with increased carbon content can be processed crack-free, therefore, a suitable process control was tested with and without preheating the working plane.

For this purpose, a material tailored to the requirements of rolling bearings, which have a carbon content of 1.38 wt.-%, was developed with reproducible properties. The focus here is on industrial application, for which processing such material with SLM plants should be made possible. To accomplish this, laser powers of ≤ 400 W and preheating temperatures of ≤ 500 °C were used.

Results

Thanks to suitable process control, SLM with preheating can be now used to produce an alloy with a carbon content of 1.38 wt.-%) without cracks, with a density of more than 99.95% and a hardness of more than 60 HRC.

Applications

The possible fields of application of SLM-manufactured components made of steels with high hardness are mechanical and plant engineering as well as toolmaking.

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1 Exposure of specimens made of high-carbon steel.

2 Etched cross section of a high-carbon steel component.