Lightweight design with laser

How can selective laser melting of metal powder be used to develop automotive lightweight structures subjected to cyclic loads? The Technische Hochschule Mittelhessen is focussing on this issue in a 600,000 euros project funded by the Federal Ministry of Education and Research. The project is led by Professor Dr. Udo Jung from the Competence Center for Automotive, Mobility and Materials Research. The Friedberg-based researchers are working together with Continental Engineering Services from Frankfurt.

Selective laser melting is a 3D printing technology used in industry, in which a product is being built layer by layer. A laser beam controlled by a CAD dataset is melting at temperatures of several hundred degrees a very thin powder bed. Processing is done layer by layer in vertical direction.

Compared to other conventional methods additive manufacturing has several advantages. Limitations of the traditional production that must, for example prevent cavaties and undercuts in casted parts, do not exist. Without a tool change each component can be manufactured differently than the previous one. This makes small series and individual component production more attrative. Spare parts can be produced locally when needed, which makes expensive warehousing redundant.

For the automobile industry this technology, which is so far primarily used by the aviation industry and medical technology, “can make an important contribution to the low-emission and resource efficient mobility by reducing the mass“, according to Jung. Material and component properties such as strength, stiffness and ductility are indispensible in this process. The material consistence in the surface layer of the component is decisive. There must be no gas inclusions (voids) and defects such as not melted powder.

“The goal of our project is to develop and produce, with the use of suitable laser scanning strategies, vehicle parts that are showing in the areas close to surface a high quality. In reverse when using laser melting on the inner regions that can have a lower quality the production time and production costs can be reduced without affecting the quality“, explained the leader of the Laboratory for Leightweight Design and Structural Durability.

“The targeted insertion of such graded material properties by modifying the manufacturing process of the laser scanning and buildup strategy of metals has not been investigated yet. In doing so we see the chance to improve the process of metal laser melting and to use it for a new vehicle technology“, said the mechanical engineer.

This process could be considered for components such as wheel suspensions like wheel carrier and suspension strut or engine mounts subjected to heavy cyclic loads, he added.

The project has a four-year term and is funded in the scope of the “Forschung an Fachhochschulen“ (Research at universities of applied sciences) programme, that has among others the goal to promote young scientists. For this reason a doctorate is included in this Friedberg-based project. Cooperation partner is Professor Dr.

Michael Vormwald from the Materials Mechanics Group of the Technical University of Darmstadt.

Fotos

Professor Dr. Udo Jung (left) and doctoral candidate Andreas Kern are preparing a rotating bending test rig for the testing of a materials specimen.

A brake caliper that has been produced using the 3D printing technology