Artificial bone generated by computer

How light can a lightweight component be? How large can pores become before stability suffers? A new simulation program, on show at the Hannover Messe in Hall 16 Stand D16, can compute the internal structure of components.

This technology takes its lead from nature: Bones are masterpieces of lightweight construction that can withstand immense stresses. Under the hard external layer sits a porous structure. The holes in this sponge are not the same size everywhere in a bone. Areas subject to particular stress, such as the femoral head, have larger pores than areas that only have to withstand forces in one direction, such as the thin middle section of the femur.

"We can now simulate on the computer the sort of internal structure a component needs so it is optimally designed for a specific application", reports Andreas Burblies from the Fraunhofer Institute for Manufacturing Engineering and Applied Materials Research IFAM. The workpiece – only the computer model of course – is broken down into tiny cubes. The required strength can then be calculated for each of these elements as soon as the external forces acting upon the component are known. The Bremen-based researchers are now also applying this finite element process on porous materials used for lightweight construction, such as the metal foams used by the car industry. They can determine where the pores must be small and where larger holes are acceptable.

So far though it has not been possible to manufacture these types of components to given specifications. Because metal foams are manufactured in a similar way to cake, namely, from a metal powder and a raising agent that releases a gas during 'baking' – in other words when the metal melts. Varying densities cannot be produced using this method. The Bremen-based researchers therefore turned to rapid prototyping. A laser beam only melts the metal powder where the pore edges are later to be found. Any remaining powder is then removed. Layer by layer this creates an open-pored material that has precisely the right density at each point. "We can therefore produce components that meet stringent requirements with minimal weight", enthuses Andreas Burblies.

Manufacturers of bone implants are among those interested in this technology. Implants are currently manufactured to millimeter precision but are made from solid titanium. Implants would be able to withstand the stresses even longer if they take the lead from the internal structure of their natural counterparts – a hope shared by companies, physicians and patients alike.

Paesi

Austria, Belgium, Czechia, Germany, Denmark, Estonia, Greece, Spain, Finland, France, Hungary, Ireland, Italy, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Poland, Portugal, Sweden, Slovenia, Slovakia, United Kingdom

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