Perfectly shaped solid components

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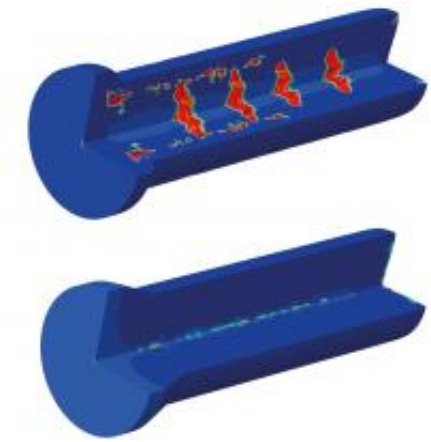

The simulation shows the results of cold forging. An optimized tool geometry (bottom) keeps pore density low. (© Fraunhofer IWM)

(PhysOrg.com) -- When metals are shaped, the materials they are made of are often damaged in the process. One cause of this is excessive press force, which cracks and perforates the material. By running simulations on a PC, research scientists can now calculate how to avoid component defects.

There are plenty of shiny new automobiles to see at the auto trade show. Over there stands a Porsche covered in gold leaf, and on the other side a Bordeaux-red Mercedes is presented. But behind all the glitz and glamour, the process involved in producing these luxury cars is long and arduous. The properties of the materials used are complex and a number of complications can arise during manufacture. The steel fabricators at

the front end of the production chain have to negotiate the first hurdle. They shape solid pieces of metal to make sheets, tubes, rods and bars, which the car manufacturers then process further. In the shaping process the materials can suffer damage if they are excessively deformed, because the friction is too high or the temperature of the forming tool is not exactly right.

To produce a defect-free component, the manufacturers not only have to make numerous prototypes with the right material properties, but also work out by trial and error how the forming tool needs to be set. This is time-consuming and expensive. The research scientists at the Fraunhofer Institute for Mechanics of Materials IWM in Freiburg have succeeded in reducing the cost of this process with the aid of computerized models.

"With our numerical simulation we can calculate how much deformation a component can withstand before cracking. And we can analyze the effect of factors such as press force and lubricants on the properties of the material," explains Dr. Dirk Helm, project manager at the IWM. The commercial software currently available cannot predict the deformation behavior of solid metal components in as much detail as his simulation routines. Helm: "We found that by making a specific change to the geometry of a shaping tool unwanted perforations were avoided because the pore density did not rise sharply but only slightly. With our simulation we can identify the optimal properties of components and shaping tools much more quickly than by trial and error." The research scientist is convinced that these simulations will considerably reduce the amount of waste material.

The software has already proved itself in actual practice. So far the experts have used their numerical simulation in cold-shaping processes in which the temperature of a tool is not a factor. In future the computer simulation will also be used for hot shaping.

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