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IEHK Steel Institute
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Key data

Funding period	4 years
Projects	16
Doctoral researchers	17
Non-research staff	13
Student assistants	18

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Homepage

http://www.trr188.de

DFG Deutsche Forschungsgemeinschaft

TRR

DAMAGE CONTROLLED FORMING PROCESSES

Collaborative Research Center

2017 - 2020 (first funding period)

Main instititutions

technische universität dortmund

RWTH AACHEN UNIVERSITY

Other institutions involved

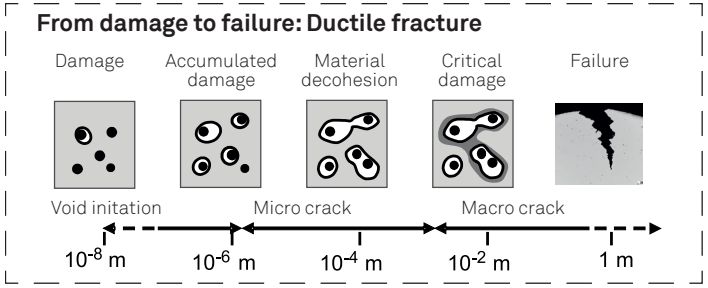
Brandenburg University of Technology Cottbus - Senftenberg

Max-Planck-Institut für Eisenforschung GmbH

Motivation

A major engineering challenge of our time is the provision of high-strength, high-efficiency components for a wide variety of applications in transport engineering, machine construction and infrastructure.

Forming processes play a key role in the manufacture of such components made of metal materials. Not only do they enable the economical production of geometrical shapes with reproducible high quality, but can also influence important component properties. This means that different forming processes and production sequences can lead to identical product geometries but different component properties for the same component material. So far, the reasons for this are only partially known. While deformation-induced hardening and residual stresses are controllable and can be used to increase the performance of the component, this does not apply to damage.



Goals and vision

The TRR 188 would like to understand material damage during the forming process in order to be able to precisely predict it, and adjust it in a targeted manner to the component performance. For this purpose,

- methods for the modeling of the damage development along the forming process chain, taking into account material-physical relationships,
- technologies for the quantitative assessment of damage, and
- technologies for technical use will be developed.

The **guiding principle** is:

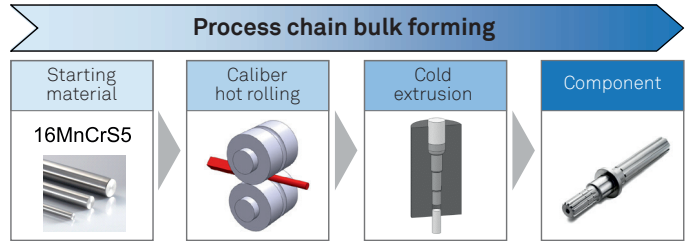
Damage is not a failure!

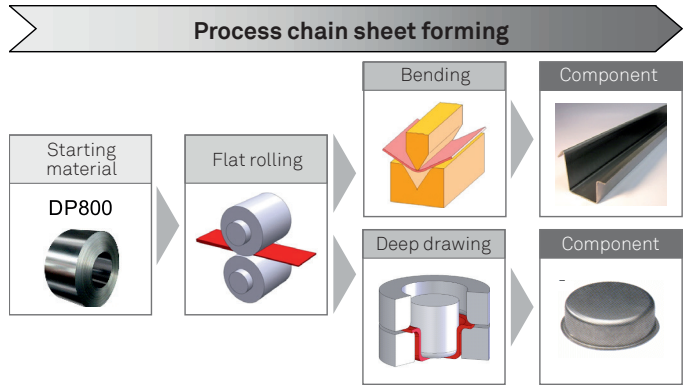
Based on this, two **paradigm shifts** are aimed at:
In **product design**, production-induced component properties, including damage, should be taken into account instead of the nominal material properties.
The **design of the forming processes** should not be based only on formability but also on the maximum performance of the products.

This creates a fundamental prerequisite for a new generation of lightweight products that deliver guaranteed tailor-made performance with low mass.

Research program

The processing takes place in three successive funding periods of four years each on the example of representative process chains for solid and sheet metal forming.





1. **Funding period (granted)**
   The core aspect is a basic understanding of the damaging mechanisms involved in the forming process and their interactions. For the analysis and evaluation of the damage initiation and evolution, material-scientific measuring methods are used and expanded. At the same time, existing modeling approaches for the damage in forming processes are evaluated and new models are developed on the basis of materials science and manufacturing technology. Both characterization and modeling are carried out from the nano to the macro scale.
2. **Funding period (planned)**
   Further development of technologies and modeling tools, as well as combination of the approaches into a continuous, scale-bridging consideration of the damage development.
3. **Funding period (planned)**
   Development and optimization of damage-reduced forming process chains.

Structure of TRR 188

The TRR 188 is divided into three project areas, each with five projects. A so-called service project, which coordinates the development and application of the modeling approaches, acts as a central interface between the two areas. In addition, three cross-cutting topics are investgated across projects and locations by means of working groups.