Institute of Applied Powder Metallurgy and Ceramics at RWTH Aachen University e.V. (IAPK)

IAPK/DE, the new network partner of CERAMIC APPLICATIONS, is also in process to set-up a permanent exhibition for all partners at the institute in Aachen/DE to promote technical ceramic components for their wide range of application.

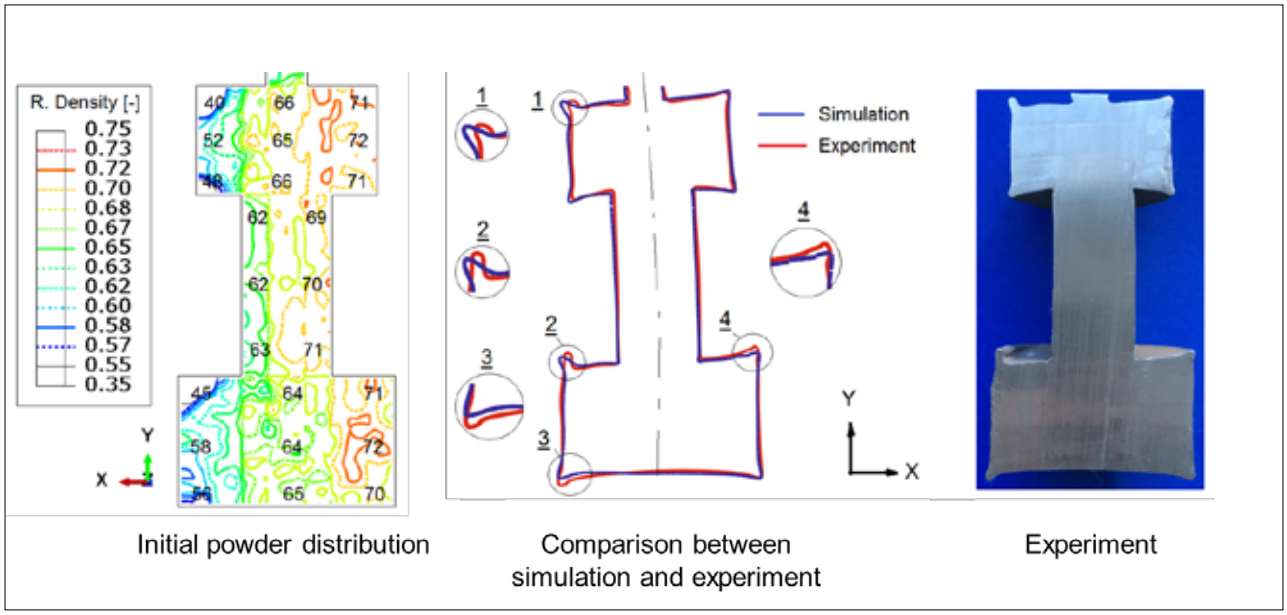

Fig. 1
Influence of inhomogeneous initial powder distribution on the final shape (DFG, contract No. BR 1844/6-2)

Research profile

The Institute of Applied Powder Metallurgy and Ceramics at RWTH Aachen University e.V. (IAPK) is an affiliated institute of the RWTH Aachen University/DE forming an institute association together with the Institute for Materials Applications in Mechanical Engineering (IWM)/DE. The IAPK acts as an interface between science and practice. The institute cultivates close contacts with its partners with the aim to transfer research results directly into economic processes and industrial applications.

The key issues are powder metallurgical and ceramic material development and component manufacturing considering the entire process chain: design and simulation, powder preparation and shaping, consolidation with sinter processing, heat treatment and component testing.

Essential requirement for the development of PM parts with improved properties are detailed understanding of mechanisms and impact factors during powder consolidation. Numerical simulation of the sintering process e.g. during Hot Isostatic Pressing (HIP) aims to predict the final shape of PM HIPed components. For accurate prediction of the final component shape a phenomenological densification model based on Abouaf has been enhanced and implemented into Finite Element software Abaqus. Moreover the effects of inhomogeneous initial powder distribution, temperature gradients and capsule design on the final shape of HIPed components have been studied. The detailed knowledge of different influencing factors on the densification of steel powder during HIP shows that the "history" of upstream processes like powder production, powder handling and filling is extremely important for the precise

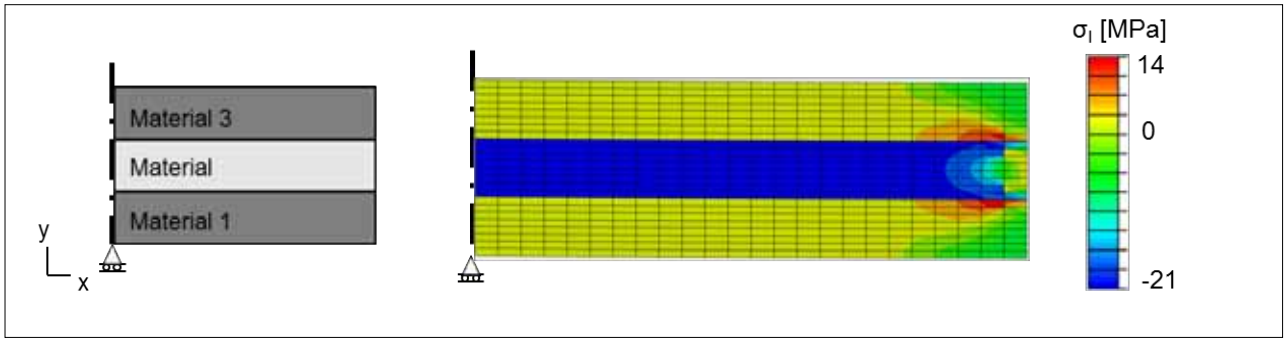

Fig. 2
Example of the stress distribution after sintering a 3-layered ceramic laminate (BMWI, FK 03ET7011R)

prediction and the reproducibility of the HIP-process. Fig. 1 shows the influence of the powder distribution and the relative density on the shape of the HIPed component.

Another example of sinter simulation within the powder technological process chain is a research project, which considers the stress formation in co-sintered heterogeneous multilayer ceramic laminates. During co-sintering, differences in sinter shrinkage and thermal expansion of the laminate constituents leads to the generation of internal stresses (Fig. 2) weakening the layers or even resulting in a complete delamination and damage. To predict and control the residual stresses the Skorohod-Olevsky model for viscous sintering was modified and implemented in an FE environment, which allows for the simulation of the residual stress state and laminate deformation, as well as the determination of processing conditions that reduce critical stresses during sintering for arbitrary laminate layups.

Besides activities in the field of process simulation, IAPK offers FEM-based lifetime predictions under specific service conditions and simulation results are validated by mechanical testing. Safety validation and stress analysis requires a number of mechanical and thermo-physical material parameters and application-oriented testing procedures.

For their identification IAPK has the necessary expertise and access to comprehensive modern testing facilities. In addition special attention is paid on joining technologies in particular adhesive joints between ceramic and metallic materials and ceramic structures with metal brazes or glass solders.

For research and services IAPK has full access to the modern equipment of its institute association (IWM and IAPK). For powder processing there are several uniaxial presses, a Cold Isostatic Press (CIP), a Hot Isostatic Press (HIP), a machine for Field Assisted Sintering (FAST/SPS) as well as a large number of sintering furnaces.

The institute`s services

In each field of its expertise the institute offers contract research. Furthermore the institute provides a wide range of services in the areas of consulting, failure analysis, mechanical and thermo-physical testing as follows:

Materials characterization with:
- Light optical- and scanning electron microscopy (LOM and SEM)
- Energy dispersive X-ray spectroscopy (EDX)
- X-ray diffraction (XRD).

Testing of metals and ceramics:
- Micro- and macro-hardness
- Fatigue behaviour and fracture mechanics on specimen and components
- Statistical evaluation
- Database inquiries for material parameters and mechanical properties
- Mechanical tests up to temperatures of 1400 °C.

Failure analysis on metals and ceramics with:
- Investigation of fatigue and creep fracture
- Fractographic analysis of ceramic and metallic samples and components.

A strong network – IAPK Association

IAPK is a non-profit organization and is supported by the IAPK association. This association consists of individuals and companies from the technical ceramics and the powder metallurgy industry. The association promotes the scientific work in its institute. Furthermore the association builds a strong and competent network of experts. The members benefit directly from this: For example, due to the quick access to the most recent research results of the institute or the active co-creation of the institute`s research. Annual seminars with favorable conditions for members are offered, contact with Bachelor and Master students is established and information is given about the institute´s current research work via newsletter. For detailed information please contact IAPK or visit the website.

Institute of Applied Powder Metallurgy and Ceramics
at RWTH Aachen University e.V. (IAPK)
Univ.-Prof. Dr-Ing. Christoph Broeckmann
Head of Institute
Augustinerbach 4
52064 Aachen
Germany

Contact person:
Dipl.-Ing. Anke Kaletsch
Tel.: +49 (0) 241-809-55-34
Fax: +49 (0) 241-809-22-66

info@iapk.rwth-aachen.de
www.iapk.wrth-aachen.de