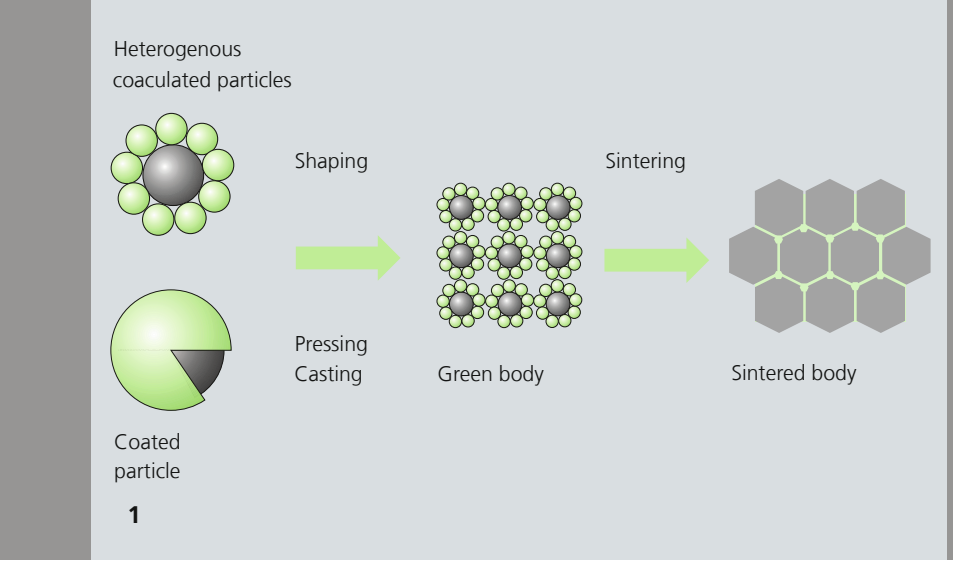

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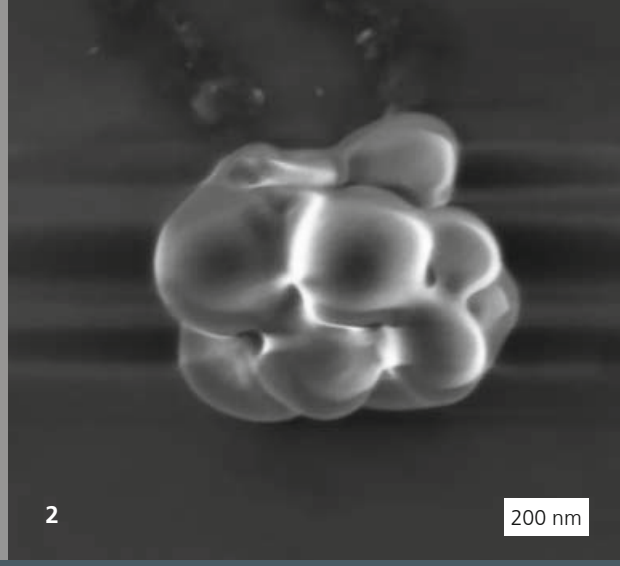

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CORE-SHELL COATING FOR IMPROVED HARDNESS AND STRENGTH OF ZTA CERAMICS

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Zirconium oxide-toughened alumina ceramics (ZTA) possess several remarkable properties. For example, they are less prone to hydrothermal degradation than pure zirconia ceramics, which makes them very suitable for medical applications. Furthermore, they are much tougher than unstrengthened alumina ceramics. Also, when compared with zirconia-based ceramics, ZTA ceramics are in many cases more cost-efficient. The homogenous distribution of the alumina and zirconia phases, however, has proven to be the most critical factor for the mechanical properties of a mixed-oxide ceramic. The efforts within the scope of the growth core "pades – Partikeldesign Thüringen" focused therefore on developing ZTA ceramics with a more homogeneous phase distribution (with comparable grain size and material density) in order to achieve the highest possible strength and hardness.

For wet-chemical coating of particles different methods are applied. One possibility is the heterogeneous coagulation of solid particles by variation of surface charges and another one is the coating of solid particles with a liquid second phase. Within the presented project the second approach was used. As a first step, the commercially available powdered raw material, alumina (Al_2O_3), was coated with the second phase, zirconium dioxide (ZrO_2), in a wet-chemical process. In addition to very small quantities (< 100 g) – produced in a rotary evaporator – larger quantities can also be produced in the rotary kiln. The particle coating (core shell) produced on an alumina powder already shows the uniform distribution of the second phase (Figure 2). Subsequently, the material was processed mainly by uniaxial pressing. The ceramics thus produced have up to 20 % smaller grain sizes after sintering compared with ceramics produced using conventional raw materials. The new technology for refining the microstructure of a composite ceramic is easy to use on an industrial scale and also relatively cost-efficient. Furthermore, the described method can be transferred onto other materials as well.

Services offered

- Materials synthesis and development based on commercially available raw materials and unique developments with the emphasis on dense, single-phase and multi-phase oxide ceramics based on sintered corundum (Al_2O_3), spinel ($MgO{\cdot}Al_2O_3$), zirconium oxide (ZrO_2) or other oxides (Y_2O_3, $Y_3Al_5O_{12}$, etc.), dispersion structures or composite materials
- Material-specific shaping and development of prototypical components and pilot series
- Accompanying characterization and analysis
- Consultation on material, design and application-specific questions

pades partikeldesign thüringen from particle to functionality

Bundesministerium für Bildung und Forschung

1 *Schematic view of an ideal process chain including coated powder.*

2 *FESEM image of a ZrO_2-coated Al_2O_3 particle before calcination (image: Friedrich Schiller University Jena, OSIM, Chair of Material Science).*

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