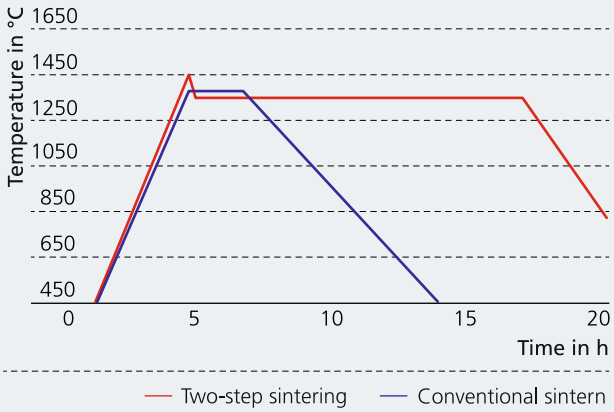

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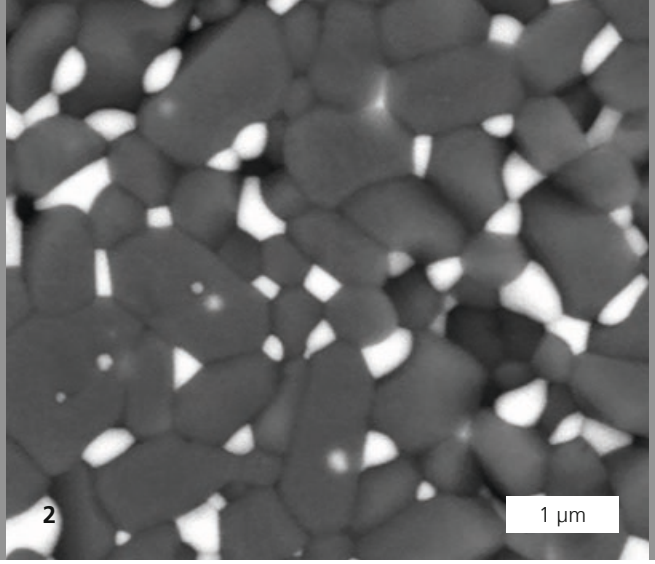

2

ENERGY-EFFICIENT TWO-STEP SINTERING OF ZTA-CERAMICS

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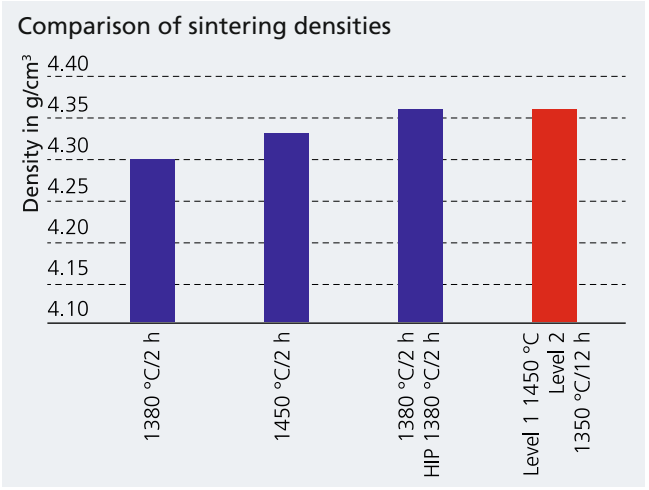
Zirconia (ZrO_2)-toughened alumina (Al_2O_3), known as ZTA ceramics, belongs to the mixed oxide ceramics and is more hydrothermally resistant and stronger than pure ZrO_2 or pure Al_2O_3. ZTA ceramics are therefore ideally suited for medical applications. The distribution of the individual phases is decisive for the improved properties of mixed oxide ceramics: A homogeneous phase distribution and high sintering density result in higher strength and hardness. ZTA ceramics are conventionally produced either through single-step sintering or through post-compaction via hot isostatic pressing (HIP) after sintering, which is energy- and cost-intensive. Fraunhofer IKTS has established a two-step sintering method, which achieves the same dense microstructure (with comparable grain size) as conventional methods but is considerably more resource- and energy-efficient.

The green bodies were initially produced by grinding the commercially available raw materials (75 wt % Al_2O_3 and 25 wt % ZrO_2 – stabilized with 3 mol% yttrium oxide) in a high-energy ball mill, followed by spray granulation and subsequent shaping using the dry pressing process. Green bodies with a density of > 56 % theoretical density were divided into three groups – the first was sintered conventionally in air, the second subsequently treated with HIP, while the third group was sintered in air in two steps. The sintering densities show that two-steps sintering compacts much better than single-stage sintering, with a complete compaction of > 99.9 % of theoretical density (corresponds to 4.36 g/cm³). In comparison with sintering and the subsequent cost-intensive HIP treatment, two-step sintering achieves equally good results in terms of sintering density and microstructure. Thus, two-stage sintering is a promising alternative sintering method to increase energy efficiency.



Services offered

- Material synthesis and development on the basis of commercially available raw materials
- Material-specific shaping and development of prototype components and pilot series
- Consulting on material-, construction- and application-specific issues

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1 *Thermal profile of two-step sintering.*

2 *Microstructure of ZTA ceramics after two-steps sintering.*

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