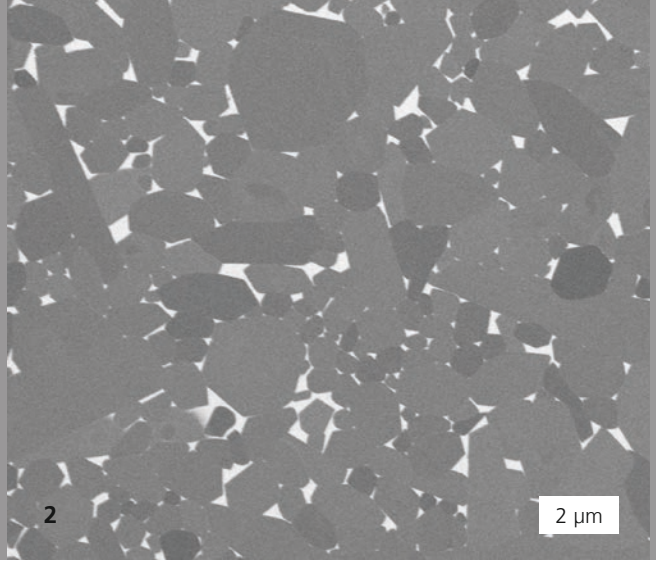

SIALONS – A SPECIAL CERAMIC PRODUCED WITH LESS EFFORT

Dr. Eveline Zschippang, Fabian Loepthien, Dr. Anne-Katrin Wolfrum, Dr. Mathias Herrmann, Dr. Manfred Fries

Alpha and alpha/beta sialons are solid solutions of silicon nitride. Their advantage is their higher chemical resistance and hardness compared with silicon nitride (Si_3N_4), with the fracture toughness being almost equal. This not only makes them interesting for application as cutting tool material for the high-speed machining of high-temperature alloys (used in aviation, automotive, energy production and plant engineering), but also as a material for chemical, mechanical and plant engineering. Also, sialons are receiving more and more attention for applications in high-power LEDs because their luminance and color do not change significantly with the temperature thanks to their high temperature stability. However, sialon materials are far less established than silicon nitride, as their production costs have previously been significantly higher. To produce sialons, alumina nitride (AlN) powder is used, which is sensitive to hydrolysis. This makes aqueous processing difficult, so that solvent-based processing is usually required, which has special requirements for labs and staff. Fraunhofer IKTS has now developed a cost-effective aqueous processing route that minimizes the hydrolysis of AlN during the processing of sialon granulates. This allows the reproducible production of different sialon compositions, which can be used both for wear applications and for optically active materials. Since sintering and structure formation in sialon materials are different from Si_3N_4 materials, the process also allows the use of cost-effective silicon nitride powders without a significant difference in properties compared with the use of high-end powders. The manufacturing processes developed in the laboratory were successfully scaled up on a small scale (10 to 25 kg powder base). The developed granule with a specially adapted binder system shows a very good compaction behavior and enables compaction via uniaxial or cold isostatic pressing. The green parts could be machined very well by milling, turning and drilling. Different drillings, chamfers and grooves could be brought in without errors (Figure 1). The microstructure (Figure 2) of the densely sintered material is very homogeneous and leads to excellent properties: For example, an alpha/beta sialon (80:20) has a hardness (HV10) of 18.5 GP, a 4-point bending strength of > 750 MPa and a fracture toughness of 5 MPa $m^{1/2}$ (SEVNB). The material properties and chemical resistance can be further adapted by varying the alpha/beta sialon ratio and the oxidic grain boundary phase.

Services offered

- Optimization of the materials properties for optical or tribological applications
- Characterization and development of functional or ready to press powders

The IGF Project 20076 N of the German Ceramic Society (Deutsche Keramische Gesellschaft / DKG) is supported via AiF within the program for promoting the Industrial Collective Research (IGF) of the German Ministry of Economic Affairs and Energy (BMWi), based on a resolution of the German Bundestag.

Supported by:
Federal Ministry for Economic Affairs and Energy

1 *Uniaxially pressed component after green machining.*
2 *FESEM image of the microstructure of the sintered sialon material.*

Contact Eveline Zschippang • Phone +49 351 2553-7983 • eveline.zschippang@ikts.fraunhofer.de