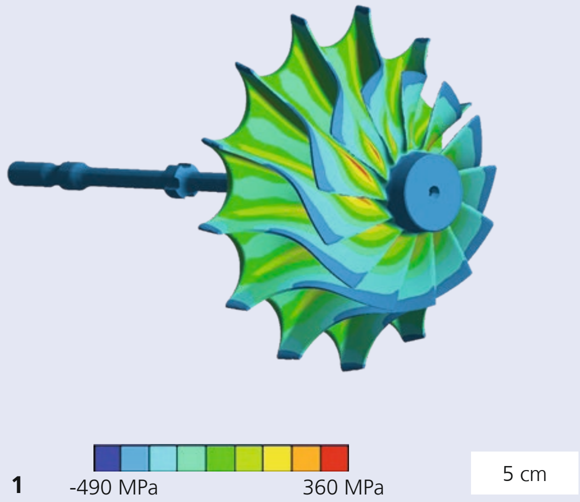

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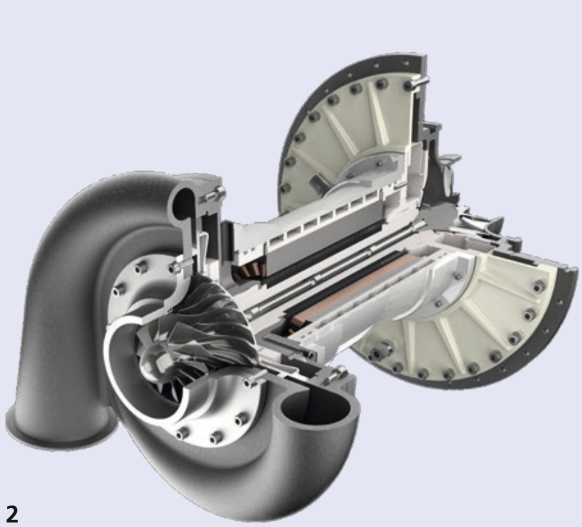

2

TURBINE COMPONENTS MADE OF SILICON NITRIDE

Dr. Willy Kunz

Small gas turbines, called "micro gas turbines" (MGT), provide electrical energy in the power range up to about 200 kW. Their compact design enables flexible, decentralized use, for example for the energy supply of buildings and larger plants. With the emergence of e-mobility, further innovative fields of application with extremely high economic potential have developed. For example, MGTs used as range extenders in buses enable highly efficient passenger transport. Noise pollution is significantly lower than with piston engines – a significant increase in passenger comfort. Another advantage is fuel flexibility. Besides fossil fuel gases, renewable energy sources such as biogases and synthetic liquid fuels can also be used in the future. Further innovative concepts for energy supply are already part of current research, for example the symbiotic combination of high-temperature fuel cells and MGT.

Nothing turns without the right material

Besides the numerous advantages, there are still some challenges to be solved. The use of biogenic fuels leads to increased corrosion. Electrical efficiency needs to be increased and the usability of hydrogen or hydrogen-rich gases must be addressed. However, this is where current plant concepts, which rely on metallic components, reach their limits.

Advanced ceramics as a motor for the turbine

To increase the performance of turbine components, Fraunhofer IKTS is researching suitable high-performance ceramic materials. In the "BonoKeram" project (FKZ: 03EE5032A), funded by the German Federal Ministry for Economic Affairs and Energy, a rotor made of silicon nitride for a 60 kW_{el} micro gas turbine is currently being developed and its long-term stability tested. This is done in cooperation with the Fraunhofer Institutes IPK and SCAI as well as industrial partners.

Based on the experience of previous projects, the silicon nitride material is specifically adapted to the load situation in the turbine. The material must meet the following criteria: very high strength, oxidation and corrosion resistance, as well as sufficient creep resistance. The aim is to provide a durable material for turbine inlet temperatures of up to 1400 °C. In the future, this will lead to new generations of microturbines that can burn biogenic (corrosion) or hydrogen-rich fuels (extreme temperatures) with increased efficiency.

Services offered

- Material development and characterization
- Design and optimization, failure analysis

Supported by:
Federal Ministry for Economic Affairs and Energy

1 *Simulation of stress distribution in a ceramic motor.*
2 *Center piece of a gas turbine.*

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