

# Advanced Microturbine Systems

The U.S. Department of Energy Distributed Energy Program is currently leading a national effort to design, develop, test, and demonstrate a new generation of microturbine systems that are much cleaner, more affordable, more reliable, and more efficient than products that are commercially available today.

## Goals:

**High Efficiency** – Fuel-to-electricity > 40% LHV

**Environment** – NO<sub>x</sub> emissions < 7 ppm when using natural gas

**Durability** – 11,000 hours of operation between major overhauls and a service life of at least 45,000 hours

**Cost of power** – Installed cost < \$500 per kilowatt (cost of electricity competitive with alternatives)

**Fuel Flexibility** – *Multiple* fuel capacity

## Advanced Microturbine Development:



General Electric



Capstone

Ingersoll Rand

## New Program Activities:

- Kennametal and Saint-Gobain Ceramics and Plastics are working to modify and upgrade existing lower-temperature sialon and silicon nitride materials for higher-temperature turbine applications.

### Saint-Gobain Ceramics and Plastics

**Objective** – Develop and optimize a high-temperature ceramic material and process suitable for microturbine applications up to 1300°C



Saint-Gobain products

Properties

NT154  
(Optimization)

Processing      Microstructure

#### Property Goals

- Fast fracture  
RT –  $\sigma \geq 950$  MPa  
1300°C –  $\sigma \geq 600$  MPa
- Fracture toughness  $\geq 6.5$  MPa $\sqrt{\text{cm}}$
- Weibull Modulus  $\geq 12$

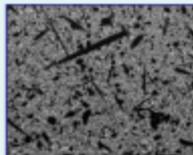
- High-temperature creep rate  
 $\sim 1.9 \times 10^{-8}$  @ 1250°C/130 MPa
- Oxidation resistance up to 1250°C
- Recession resistance in humid environment up to 1250°C

### Kennametal

**Objective** – Modify and upgrade existing low-temperature sialon for turbine applications



Sialon cutting tool



$\beta$  reinforced  $\alpha$  sialon

- Component fabrication via low-cost sintering process
- Tailor sialon properties to meet demands of microturbine applications

- Optimize grain boundary composition for improved environmental stability

## Contact Information:

D. P. Stinton  
(stlntondp@ornl.gov), Phone (865) 574-4556  
Oak Ridge National Laboratory, Oak Ridge, TN 37831-6065



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