FETC SUCCESS
U.S. Department of Energy
Federal Energy Technology Center

CLEAN AFFORDABLE POWER

- [x] fossil energy
- [ ] environmental
- [ ] energy efficiency
- [ ] other

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Toughened Ceramics

States Impacted:
Tennessee, Pennsylvania, Ohio, West Virginia, Minnesota, South Carolina

Benefit Areas:
Technology Leadership, Environment

Participants:
ORNL, 3M, Greenleaf Corporation, Advanced Composite Materials Corporation

FETC Contact:

Udaya Rao*

Office: (412) 386-4743
E-Mail:rao@fetc.doe.gov

MAIL ADDRESS:

* U.S. Department of Energy
P.O. Box 10940
626 Cochrans Mill Road
Pittsburgh, PA 15236-0940

**U.S. Department of Energy
P.O. Box 880
3610 Collins Ferry Road
Morgantown, WV 26507-0880

WEBSITE:
www.fetc.doe.gov

Description

Strong, durable ceramics markedly improve the energy performance characteristics of equipment used in a wide variety of high-temperature applications, ranging from automobile, airplane and heavy-duty engines, to industrial applications, oil refineries combined-cycle power plants. Early stages of development dealt with brittleness, unreliable strength, and poor resistance to extreme changes in temperature. Despite these problems, the Department of Energy (DOE) recognized the promise of this technology and sponsored basic research, including computer modeling of toughening mechanisms and fundamental studies of the interface between ceramics and the toughening agents.

Coupled with the basic research, DOE has also sponsored applied research. A new ceramic compound, silicon carbide whisker-reinforced alumina, was developed in the early 1980's and is now used in a wide variety of industrial applications, including metalworking die inserts and fastcutting machine tools. Ongoing support for R&D on ceramics continues to yield important technological advances, such as gelcasting, a precision complex-shape-forming process that yields a near-net-shaped part that requires minimum machining. Another advance is a lightweight ceramic hot-gas filter material used to remove hot gas particulates in fossil energy power generation and industrial systems, improving the efficiency and productivity of the parent system.

Goals

Because of their superior high temperature properties, the goal of this project is to develop ceramic composites for heat exchanger tubes and hot gas filters for energy production and conversion systems. Corrosion resistant coatings for heat exchanger tubes will also be developed.

Tangible Benefits

National: Current estimates of worldwide sales of products made from the new ceramics by U.S. companies are more than $30 million per year. In fact, the filter material has been licensed for commercial production with a potential international market of $7 billion over the next 10 to 15 years. The U.S. market alone is forecasted to reach $200 million annually by the end of the century.

Regional/Local: Coal producing areas of West Virginia, Pennsylvania, and Ohio will benefit from improved coal use in power generation with reduced environmental impacts through the use of ceramic filters for cleaning fuel uses. In addition, over the next 15 years, the possibility exists that conventional pulverized coal systems will be replaced with advanced, high-efficiency systems, and companies such as Siemens-Westinghouse and McDermott would supply the required ceramic filters.

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