DuPont Lanxide Composites Inc.

Directed Metal Oxidation

CFCC

Objective

The DuPont Lanxide Composite team is developing functional and cost-effective CFCC components via the DIMOX™ directed metal oxidation process. This materials fabricated using the DIMOX™ process can be integrated into enabling systems, or offer retrofit opportunities in advanced heat exchanger and industrial power generation applications.

Materials and Processes

Two types of composite material are being considered by this team. The first is a Nicalon™ silicon carbide fiber-reinforced alumina matrix composite, which has good high-temperature strength and fracture toughness, high thermal shock resistance, and excellent elevated temperature stability. The second material is an alumina fiber-reinforced alumina matrix composite which is being developed for its improved resistance to hot and aqueous corrosion.

The novel DIMOX™ process involves the growth of an oxide matrix through a preform with no densification shrinkage and no displacement of the reinforcement. When molten aluminum metal is placed in contact with the fiber preform it oxidizes in the presence of air at elevated temperatures and forms a matrix which is rich in aluminum oxide. Residual aluminum, which is present in the matrix as microscopic interconnected channels, is removed from the CFCC to ensure stability.

Applications and Benefits

Team members are evaluating the use of CFCCs for a variety of systems and components.

- Foster Wheeler is investigating the use of CFCCs in coal-fired combined-cycle power generating systems, including high-temperature heat exchanger tubes. CFCC components could increase plant efficiency from the current 35% to 47%, and reduce airborne emissions and solid waste by 25%.

- Solar Turbines is evaluating CFCC combustor liners for industrial turbine engines which could increase efficiency and substantially reduce NO_x and CO_2 emissions.

- General Electric Power Systems is exploring CFCC gas turbine tip shrouds for utility applications. CFCC components in turbine engine applications allow for higher firing temperatures but with lower NO_x levels, thus increasing turbine efficiency and significantly reducing environmental emissions.

Challenges

Long-term durability and reduced costs are the key hurdles to overcome before CFCC components gain market acceptance. Thus the team is focusing on the manufacturing process, trying to improve reproducibility and yield, and shorten cycle times.

Team Members

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Foster Wheeler Development Corporation
Livingston, NJ

General Electric Power Systems
Schenectady, NY

DIMOX™(directed metal oxidation) parts from DuPont Lanxide Composite showing versatile shape capability.

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Continuous Fiber Ceramic Composite Program

A 10-year joint R&D effort initiated in 1992 to develop processing methods to produce reliable and cost-effective CFCC components for industrial applications.

CFCCs are light, strong, and corrosion-resistant materials capable of performing at high temperatures.

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