Babcock & Wilcox Company

Sol Gel Impregnation

CFCC

Objective

This team is developing advanced ceramic composite materials through an approach that is ideal for the fabrication of oxide-based composites. Most importantly, the processing method can be scaled for cost-effective manufacturing operations.

Materials and Processes

The Babcock & Wilcox (B&W) team uses a powder slurry and sol-gel (liquid precursors that are converted to solids) impregnation technique to fabricate oxide-fiber reinforced oxide matrix composites. Advanced oxide ceramic fibers from 3M are wound onto mandrels, or woven into fabrics or other preforms. The residual voids within the fibrous structures are then impregnated with a solid-liquid mixture that is converted to an alumina or mullite ceramic matrix. The team is investigating various oxidation resistant fiber coatings to obtain optimal properties at the interface between the fibers and the ceramic matrix.

Oxide-oxide CFCCs were selected because of their inherent thermodynamic stability in oxidizing, high-temperature industrial applications. Prototype components will be tested and models will be developed to demonstrate CFCC component properties and reliability.

Applications and Benefits

This team is assessing several industrial applications that will have wide-spread environmental, energy, and economic benefits.

- Combustor liner for gas-fired power turbines formed by CFCC materials could save millions in production costs and reduce tons of NO_x emissions.
- CFCC heat exchanger tubes will allow higher operating temperature and less natural gas heating.
- Hot gas filters will be applied to advanced fossil energy systems, but will also offer advantages to the chemical and refining industries.
- Boiler components
- Flame stabilizer ring
- Thermophotovoltaic burner/emitter

Challenges

Control of the properties of the fiber-matrix interface remains the greatest technical challenge for the dense CFCCs. Recently identified oxide fiber coatings are showing very positive results.

Team Members

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Oxide-oxide CFCC hot gas filters for use in advanced fossil energy, chemical, and refining applications.

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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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