Technology Opportunity
Glenn Research Center • Cleveland • Ohio
Technology Transfer & Partnership Office
TOP3–00165

Environmental Barrier Coatings (EBCs) for Ceramic Gas Turbine Components

Technology

A new, low coefficient of thermal expansion (CTE) EBC for ceramic substrates used in gas turbine engines.

Benefits

Compared to existing EBCs, this new technology

- Offers superior resistance to water vapor, which allows increased use temperature and life
- Has a higher melting temperature, which again leads to a higher use temperature and life

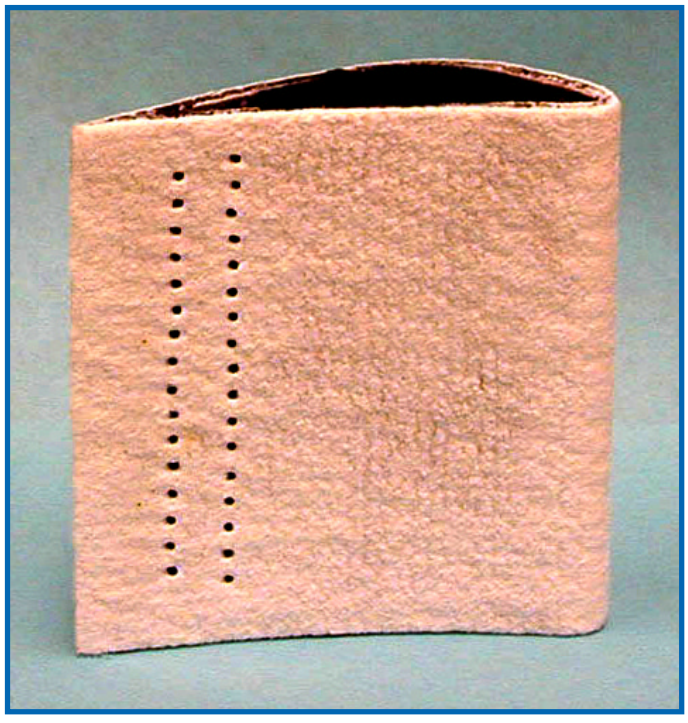

Figure 1.—Silicon/mullite+BSAS/Sc_2SiO_5 (SiC/SiC vane with as-fabricated EBC).

Commercial Applications

This technology can be used in gas turbines incorporating ceramic components:

- Aerospace gas turbine engines
- Gas turbines for industrial applications

Technology Description

In gas turbine engines, EBCs protect engine components from the volatilization and the resulting recession caused by water vapor. The new EBC is specifically designed to be used on ceramic components. This EBC has a low CTE, which matches the CTE of the ceramic components it protects. In contrast, engine components made from superalloy metals have larger CTEs, so they require EBCs with larger CTEs. If the CTE of the EBC and the component do not match, the coating will fail when the engine is thermally cycled.

The EBCs described in this technology fall into two categories:

- Oxides from Groups IVB and VB such as $HfTiO_4$ and $ZrTiO_4$
- Rare earth silicates such as $ScSiO_5$ and Yb_2SiO_5

Figure 1 shows an SiC/SiC ceramic matrix composite blade with an EBC coating having an $ScSiO_5$ topcoat. Figure 2 shows a cross section through a similar substrate. The Si layer shown in Figure 2 is applied to get a strong bond to the SiC/SiC matrix material, the mullite+BSAS (barium-strontium-aluminum-silicate) layer is applied to improve the crack resistance of the EBC layer. Any cracks in the EBC are openings for water vapor to penetrate to the SiC/SiC matrix material. As the cross section shows, the EBC layer is nonporus, which prevents water vapor penetration.

Options for Commercialization

There is a patent application in process for this technology. NASA is seeking companies interested in applying this technology to commercial applications.

References

LEW–17275–1

Key Words

Silicon carbide matrix composite

High-temperature turbine components

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300 hr, 1400 °, C-1-hr cycles, 90-percent H_2O

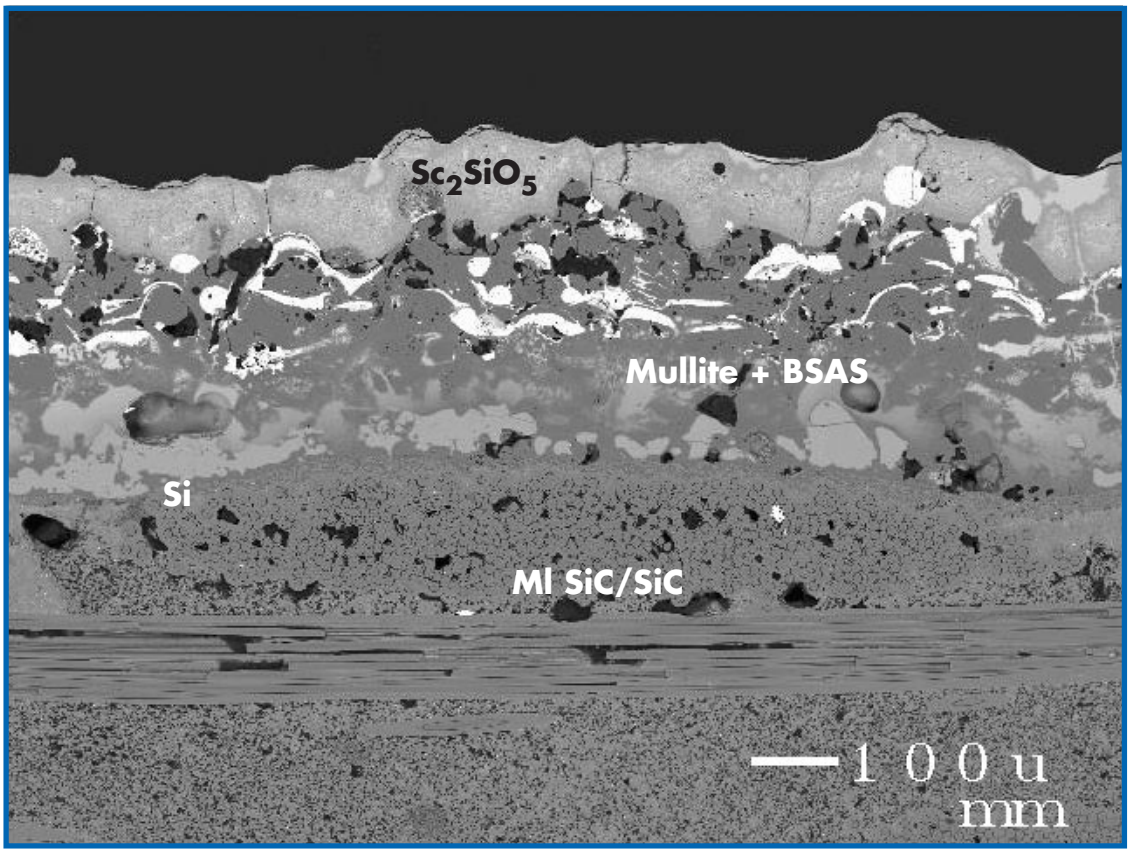

Figure 2.—Silicon/mullite+BSAS/Sc_2SiO_5.