Technology Opportunity
Glenn Research Center • Cleveland • Ohio
Technology Transfer & Partnership Office
TOP3–00172

UEET Low Conductivity Thermal Barrier Coating

Technology

NASA Glenn Research Center researchers have developed a low-thermal-conductivity thermal barrier coating that may play a major role in improving efficiency and reducing emissions in future gas turbine engine designs.

Benefits

NASA's low thermal-conductivity thermal barrier coating (TBC) has been shown to provide improved thermal protection to components in gas turbine engine environments via reduced thermal conductivity and improved sintering resistance—which means that the lower conductivity is retained at the higher operating temperatures anticipated for future advanced gas turbine engines. It is expected that other types of engines such as ground-based power and diesel applications can also benefit from this new coating.

Commercial Applications

- Aircraft turbine engines
- Gound-based power
- Diesel engines
- Steel forming (thinner coatings for mandrels, rollers, etc.)
- Power plants

Technology Description

Ceramic TBCs have received increasing attention for advanced gas turbine and diesel engine applications because of their ability to provide thermal insulation to engine components. In order to improve engine efficiency, a coating must withstand much higher temperatures while protecting the metal substrate. Current methods use a yttria-stabilized zirconia TBC and are not well suited for the flame temperatures desired for future ultra-efficient engine designs. Researchers at NASA Glenn Research Center have developed an insulating

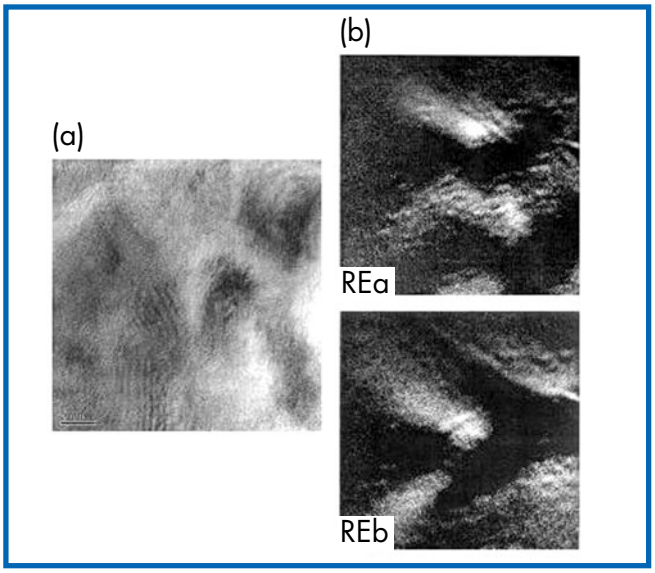

Figure 1.—(a) High-resolution transmission electron microscopy image of NASA ZrO_2—Y_2O_3–REa_2O_3–REb_2O_3 low-thermal-conductivity TBCs. (b) Energy dispersive x-ray spectrometry composition maps of REa and REb. Moire' fringes and nano-scale segregation observed. Note the nano-segregation of the paired rare earth oxides.

ceramic coating that protects air-cooled components in turbine engines and allows engines to run at much higher gas temperatures.

NASA's low-thermal-conductivity TBC achieves significantly improved properties from relatively small modifications to the current yttria-stabilized zirconia coating. The modifications are adjustments to the yttria level plus the addition of select rare-earth oxides that impart microstructural and defect properties that favor lower thermal conductivity and sintering resistance. These coatings can be applied using the conventional TBC application methods of physical vapor deposition and plasma spraying.

Options for Commercialization

NASA is interested in working with companies who are interested in applying this technology in new and innovative commercial applications.

Contact

Technology Transfer & Partnership Office
NASA John H. Glenn Research Center
at Lewis Field
Mail Stop 4–2
Cleveland, OH 44135–3191
Phone: 216–433–3484
Fax: 216–433–5012
E-mail: ttp@grc.nasa.gov
http://technology.grc.nasa.gov

References

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Key Words

Low conductivity
Thermal conductivity
Thermal barrier coating
High-temperature coating

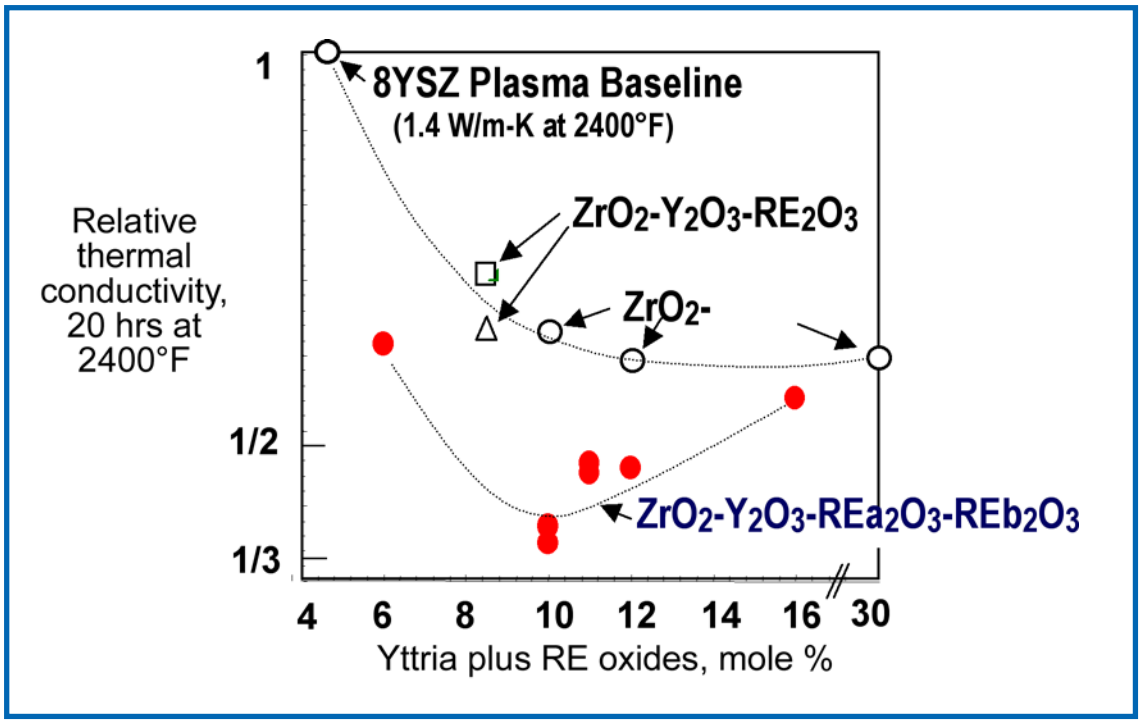

Figure 2.—The UEET low thermal conductivity TBC adds rare earth (RE) oxides which are carefully selected so as to promote reduced conductivity and resistance to sintering at high temperatures. The result is the line given by the red circles. Note the significant lowering of conductivity especially around 10-12 mole percent—which is near the beginning of the cubic phase field.

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