Investigating High Performance Ceramic Coatings for Next Generation Gas Turbines

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If you have ever flown on a jet aircraft or used electricity generated from natural gas, you have benefitted from gas turbine technology. The metallic components of gas turbines are protected from the extreme combustion temperatures by high performance ceramics known as thermal barrier coatings (TBCs). Both power generation and aviation industries aim to increase the operating temperatures of gas turbines to reap the economic and environmental benefits of improved engine efficiency. The current industry-standard TBC composition, yttria (YO\(_{1.5}\)) stabilized zirconia (ZrO\(_2\)), has inherent temperature limitations that prevent it from performing well at high (>1300°C) operating temperatures, motivating the search for new compositions with improved capabilities. Potential improvement of TBC properties is facilitated by investigating 1) opportunities to develop single phase, non-transformable compositions for improved phase stability, and 2) methods to increase the toughness of compositions that exhibit improved resistance to silicate-attack. Results from both avenues of TBC development will be discussed.