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ZIRCONIA-DOPED YTTRIUM TANTALATES AS A POTENTIAL NEXT GENERATION THERMAL BARRIER COATING MATERIAL

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Yttria-stabilized zirconia (YSZ) has been the coating material of choice for thermal protection in gas turbine engines for at least twenty-five years. Over that time, gas turbine temperatures have steadily increased and the demands on the coatings have been met largely through a combination of improved processing, enhanced performance bond-coats and modifications of superalloy compositions as well as improved cooling designs. With further increases in turbine temperature though it is unlikely that YSZ can maintain its pre-eminence and the next generation of thermal barrier coatings will have to be made from another oxide composition.

While the principal requirements of any new coating material must include being stable at higher temperatures and having lower thermal conductivity than YSZ, any new coating material will also have to satisfy several additional, often conflicting requirements. These include having high fracture toughness at high temperatures. In this talk, I will describe our studies on compositions in the zirconia-doped yttrium tantalate system since they not only exhibit very low thermal conductivities at all temperatures but also exhibit a high-temperature second-order, displacive phase transition, a prerequisite for toughening at high temperatures. The underlying physical basis for the low thermal conductivity of these compounds and the evidence for a second-order, ferroelastic transformation will be described in detail. Also a comparison with other potential materials will be presented.