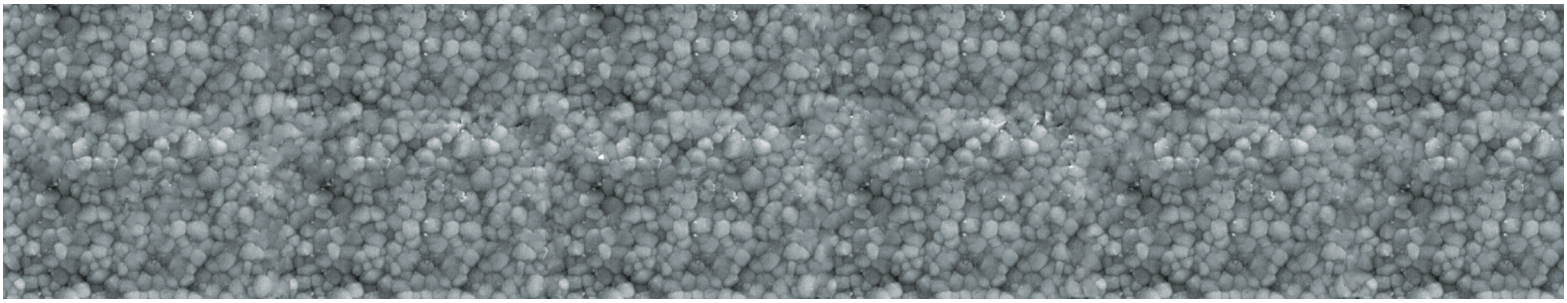
Superior Technical Ceramics

TRANSFORMATION TOUGHENING OF Y-TZP: HOW IT RESISTS CRACK PROPAGATION

(*or 'How we pinch a crack shut before it even starts'*)



OVERVIEW

Yttria-stabilized Tetragonal Zirconia Polycrystal (Y-TZP) ceramics are used when a material needs to be exceptionally strong, wear-resistant, chemically inert and also have a high fracture toughness. Particularly for biomedical applications, Y-TZP's (relatively) low Young's Modulus promotes a more elastic behavior with a bending strength and high hardness that are also useful. It is because of these helpful properties that Y-TZP ceramics are chosen for a wide range of applications from aerospace to dentistry. The real key to the utility of these advanced zirconia materials is the way that their strengths have been markedly improved. They have been described as "the ceramic analogue of steel" by a phenomenon known as "transformation toughening". This ensures that the material will be far more fracture resistant than so many other ceramics currently available.

TRANSFORMATION TOUGHENING OF Y-TZP

Materials science tells us that for polycrystalline materials such as Y-TZP, the most significant influence on the mechanical properties is the tetragonal crystal structure. Zirconia is commonly alloyed with small amounts of a metal oxide such as Yttrium oxide (Y_20_3). When a crack develops, an associated stress field around the crack also forms. This can be enough to induce the transformation of one crystal structure to another which has an approximate 3% volume expansion. This means that when a crack begins to propagate in Y-TZP, the crystal transformation due to the applied stress results in a resistance to further crack growth. Y-TZP belongs to a unique family of transformation-toughened ceramics that all have this toughening phenomenon at work within their microstructures.

MORE ABOUT Y-TZP

The transformation of a tetragonal crystal to a monoclinic crystal structure imparts the superior mechanical properties expected with most stabilized zirconia materials. The combination of stabilizer concentration and grain size is critical in providing stability to the Y-TZP material.

The Yttria concentration of approximately 5.4 weight percent in conjunction with an average grain size below 1 micron is a desirable combination for optimal stability.

In addition to the superior mechanical properties, Y-TZP components can be produced with extremely fine surface finishes. This comes primarily from the sub micron crystal size that is always associated with this family of stabilized zirconias.

SPECIFICATIONS AND APPLICATIONS

Y-TZP has a wide range of applications including: dentistry - e.g. tooth crowns, joint replacement, refractory materials, thermal barrier coatings, cutting tools, electro-ceramics and solid fuel cells.

Y-TZP RELATED SERVICES

- Powder preparation
- Forming
- Green machining
- Firing
- Grinding and cleaning
- Coating/Glazing
- Metalizing and plating
- Metrology

CONTACT US

For more information call or email us. You can also learn more about our extensive capabilities at www.ceramics.net.

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