The information provided and recommendations made herein pertain solely to matters of composition of the products based on the test believed to be reliable. The accuracy of this information is not guaranteed. Depending on the measurement methods or instruments, the result may vary from information provided herein. Since the purchaser’s actual use of the products is beyond the control of Tosoh Corporation and its related, subsidiary and affiliated companies (collectively, “related companies”), Tosoh Corporation and its related companies are neither responsible nor liable for results obtained from the use of the products. Tosoh Corporation and its related companies make no representations or warranties as to the appropriateness of the products for any use intended or made by the purchaser. Each purchaser must conduct its own testing, safety and regulatory evaluation(s).
Zirconia is a unique advanced ceramic—a chemical compound having the formula ZrO$_2$. Products manufactured from Tosoh’s yttria-stabilized zirconia (YSZ) powder exhibit superior mechanical properties such as high strength and flexibility. As a technological breakthrough, YSZ surpasses the strength limitations of traditional fine ceramics. Heat insulating properties and oxygen-ion conductivity indicate zirconia has potential for use in a wide variety of applications—everything from telecommunications and environmental products to the new energy of the future.

Tosoh is a pioneer in the development of YSZ and has become a major supplier to the world. Earning a solid reputation for consistent high purity and quality that customers can depend on, Tosoh continues to focus resources in R&D and customer services for the ultimate evolution of zirconia.

**Grinding Media**

**SUPERIOR STRENGTH and DURABILITY**

Tosoh’s zirconia grinding media is primarily spherical and comes in a variety of sizes from 0.03 mm to 25 mm. It is used to process materials for not only machines and industrial parts, but also plays a vital role in the production of materials that comprise the micron-thin layers of electronics for mobile phones, as well as the processing of pigments in printing inks.

**Dental Materials**

**COMBINING STRENGTH and NATURAL BEAUTY**

Replicating the natural look and feel of real teeth without compromising strength, zirconia is now gaining attention as a new dental material.

**Dental Materials**

**COMBINING STRENGTH and NATURAL BEAUTY**

Replicating the natural look and feel of real teeth without compromising strength, zirconia is now gaining attention as a new dental material.

**Indispensable for Fiber-Optic Networks**

The information age of today and tomorrow is being built on global fiber-optic networks. Zirconia is an indispensable material used in the connectors within those networks.

**Environmentally Friendly and Energy-Efficient**

OXYGEN-ION CONDUCTIVITY is a UNIQUE QUALITY of zirconia. This fascinating characteristic makes zirconia useful in environmental applications for solid oxide fuel cells, which generate pollution-free electricity, as well as oxygen and NOx sensors used in the automotive field.

**Mechanical Parts**

Zirconia is RESISTANT to RUST, CORROSION, and CHEMICAL REACTIONS, and therefore is used in a variety of machines and other industrial equipment. Zirconia excels in heat shielding applications, providing heat insulation to times that of standard ceramics and 100 times that of iron.

**Daily Life**

**INCREDIBLY DURABLE and SOFT** to the TOUCH, zirconia is used in consumer goods, such as luxury watches. For professional chefs, zirconia knives don’t rust and stay extremely sharp.

**The Unlimited Possibilities for Zirconia**

Zirconia is a unique advanced ceramic—a chemical compound having the formula ZrO$_2$. Products manufactured from Tosoh’s yttria-stabilized zirconia (YSZ) powder exhibit superior mechanical properties such as high strength and flexibility. As a technological breakthrough, YSZ surpasses the strength limitations of traditional fine ceramics. Heat insulating properties and oxygen-ion conductivity indicate zirconia has potential for use in a wide variety of applications—everything from telecommunications and environmental products to the new energy of the future.

**Quality Worthy of Market Share**

Tosoh is a pioneer in the development of YSZ and has become a major supplier to the world. Earning a solid reputation for consistent high purity and quality that customers can depend on, Tosoh continues to focus resources in R&D and customer services for the ultimate evolution of zirconia.
A Global Brand Earned with Quality You Can Trust

Zirconia Powder TZ Series

Using the latest hydrolysis processes and nano technologies, Tosoh has created the TZ Series of zirconia powders. Through complete control over materials and production processes, Tosoh can maintain consistent high quality and purity. The TZ Series, the ultimate zirconia powder, delivers added value and product improvements to the customer.

Basic Grades

Fine Ceramics

TZ-3Y-E

Partially-stabilized zirconia powder with uniform dispersion of 3 mol % yttria. TZ-3Y-E exhibits superior sintering properties and higher aging resistance at a lower sintering temperature of 1300°C. Sintered bodies produced with TZ-3Y-E show a fine crystal grain structure resulting in greater improvements in strength, fracture toughness, as well as resistance to wear and aging. TZ-3Y-E has numerous applications including materials for industrial parts and everyday products.

Solid Electrolyte with Oxygen-Ion Conductivity

TZ-4Y TZ-6Y TZ-8Y TZ-10Y

Fully stabilized zirconia powder with uniform dispersion of 4-10 mol % yttria. Sintered bodies produced from these powders exhibit oxygen-ion conductivity and heat insulating properties. These grades have proven to be suitable for use in oxygen sensor applications, electrolytes in solid oxide fuel cells, materials for heat insulation, and many others.

Binder Grades “B”

Tosoh's binder added grades are perfect for mechanical pressing and Cold Isostatic Pressing (CIP). “B” grades can be used “as is,” thereby eliminating the binder addition and pressing and Cold Isostatic Press (CIP). “B” grades can be used for producing large parts with a mechanical press or CIP.

Basic Grades

ATZ Grades “A”

“A” grades contain uniformly dispersed 3 mol % yttria, 20 wt% alumina, and exhibit extremely high mechanical strength after Hot Isostatic Pressing (HIP). This grade is most commonly used to produce industrial parts in high strength, high wear resistance applications.

Easy Sintering (TZ-3Y-E)

TZ-3Y-E can be sintered at a lower temperature of 1350°C. TZ-3Y-E has superior hydrothermal aging resistance.

High Translucent Grade

Dental restorations with the natural look and feel of real teeth can be produced with Zpex. Zpex Smile is a newly developed grade for anterior applications. Powder grades for dental color shades are also available.

Color Zirconia

Tosoh's color zirconia shows a deep tone that emulates jewels. Other uses include mechanical and optical anti-reflection parts.

EASY MOLDABILITY GRADES “S”

“S” grades have a smaller surface area that contributes to a smooth flow for the compound or slurry during injection molding, tape casting, and other molding methods. Therefore, “S” grades are highly recommended for producing large parts with a mechanical press or CIP.

TZ-3YS-E

TZ-3YS-E is made to even lower sintering temperature of 1300°C. Sintered bodies TZ-3YS-E can be produced from these powders exhibit oxygen-ion conductivity and heat insulating properties. These sintered bodies have a fine crystal grain structure. The product is easy to handle and is supplied in a granule form.

High Translucent (Zpex and Zpex Smile)

Zpex and Zpex Smile have high all light transmittance in addition to superior hydrothermal aging resistance.

All Light Transmittance (D65) / %

<table>
<thead>
<tr>
<th></th>
<th>Zpex4</th>
<th>Zpex</th>
<th>TZ-3YSB-E</th>
<th>Zpex Smile 1500°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Translucency</td>
<td>60</td>
<td>56</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>Aging Property</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>

Zpex and Zpex Smile are registered trademarks of Tosoh Corporation in Japan, the United States, and other countries.
Jewel-like Dignity and Elegance

Color Zirconia TZ Color

Integrity and depth of color in zirconia exudes elegance comparable to precious stones. Superior wear resistance means the brightness never fades. Color zirconia will provide the sparkle that customers need for development of new products.

Typical Applications

- Watch parts (case, band)
- Exterior cellular phone parts
- Optical anti-reflection parts for image recognition
- Various machine parts

Available Colors

- In addition to colored powder, compound for injection molding and sintered products are also available.

Typical Properties of Sintered Body

Density (g/cm³) | 6.05 | 6.02 | 5.90 | 5.80 | 5.50 | 6.08 | 6.00 |
Bending Strength R.T. (MPa)*1 | 1200 | 1000 | 500 | 300 | 200 | 2000 (HIPing) | 1100 | 1200 |
Hardness (Hv 10)*2 | 1250 | 1400 | 1250 | 1200 |

*1: JIS R1601 (3-point bending test)  *2: JIS R1610 (Loads: 98.07N)

Above colors may differ from actual colors.
Above color codes are reference numbers.
Please contact your nearest Tosoh sales office for more information or the development of a custom color.

Legend for grade names

- Example: TZ-3Y S 20A B - E

I: % of yttria
S: easy moldability grades
A: ATZ grades ~ 20 wt% alumina
B: binder grades
E: easy sintering grades
Proven Technology and Achievements

Compound for Injection Molding PXA Series and Ceramic Components

Tosoh supplies various injection molded components produced by Tosoh Ceramics Co., Ltd. Tosoh, in addition to powder production, is an injection molding compound manufacturer with extensive experience in the mass production of sintered bodies. Based on this know-how, Tosoh has developed the PXA Series delivering high quality, easy sintering, and superior handling features.

Standard Grades

◆ PXA-211P
Zirconia compound based on TZ-3Y-E.
Compounded for de-waxing with good flow; used for precision parts as well as irregular shape parts.

◆ PXA-233P
Zirconia compound based on TZ-3YS-E.
This compound can be de-waxed in air and feature excellent de-waxing properties with good flow.; used for larger parts.

◆ PXA-321P
Zirconia compound based on TZ-Black.
Black color stability can be achieved. Compounded for de-waxing with good flow; used for larger parts as well precision parts.

◆ PXA-300P Series
Color zirconia compound.

◆ PXA-400P Series
Zirconia compound based on fully stabilized zirconia powder.

Tosoh offers customized special compound to meet customer requirements, such as ceramic compound based on materials other than zirconia. Please contact your nearest Tosoh sales office for more information.

Typical Applications

● Optical fiber connector ferrule and sleeve blanks
● Watch parts
● Exterior cellular phone parts
● Auto parts
● Structural parts for medical devices
● Various machine parts

Manufacturing Process

TZ Series
Powder
Ferrule, Sleeve
Components
Injection Molding
De-waxing
Sintering
Kneading
Pelletizing
Grinding
Polishing

Typical Properties of Sintered Body

<table>
<thead>
<tr>
<th>Density (g/cm³)</th>
<th>6.05</th>
<th>6.00</th>
<th>5.50</th>
<th>5.90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bending Strength (R.T.)</td>
<td>1,200</td>
<td>1,200</td>
<td>1,400</td>
<td>1,250</td>
</tr>
<tr>
<td>Hardness (Hv10)**</td>
<td>1,250</td>
<td>1,200</td>
<td>1,400</td>
<td>1,250</td>
</tr>
<tr>
<td>Color</td>
<td>Milk White</td>
<td>Black</td>
<td>White</td>
<td>Milk White</td>
</tr>
</tbody>
</table>

*1: JIS R1601 (3-point bending test)  
*2: JIS R1610 (Loads: 98.07N)

30 Microns with Great Potential

Zirconia Fine Beads TZ-B Series

Tosoh’s high-end manufacturing technology has yielded zirconia fine beads that exhibit superior strength and fracture toughness. The TZ-B Series is now used in many applications such as blasting, shot peening, and placing sand.

Standard Grades

<table>
<thead>
<tr>
<th>Grade</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>TZ-B30</td>
<td>20 ~ 38 μm</td>
</tr>
<tr>
<td>TZ-B50</td>
<td>25 ~ 106 μm</td>
</tr>
<tr>
<td>TZ-B90</td>
<td>75 ~ 106 μm</td>
</tr>
<tr>
<td>TZ-B125</td>
<td>100 ~ 150 μm</td>
</tr>
<tr>
<td>TZ-B180</td>
<td>150 ~ 212 μm</td>
</tr>
<tr>
<td>TZ-B250</td>
<td>212 ~ 300 μm</td>
</tr>
</tbody>
</table>

For other sizes, please contact the nearest Tosoh sales office.

Typical Applications

● Shot blasting (matte finishing, deburring)
● Shot peening
● Filler for various resins
● Placing sand (sintering, annealing)
● Spacer

Durability Comparison (TZ-B30)

Test data shows the result of shot blasting SUS34 using various types of beads equivalent to TZ-B30. During the shot blasts, the crushing ratio of TZ-B30 hardly rose. This shows the superior crushing strength that the TZ-B Series provides.

<sup>PXA</sup> is a registered trademark of Tosoh Corporation in Japan.
Eco-Products with Superior Grinding Efficiency

Zirconia Grinding and Dispersion Media YTZ

YTZ grinding media, produced from yttria-stabilized zirconia powder, exhibits high crushing strength, fracture toughness and wear resistance. It is produced by the Nikkato Corporation, one of Japan’s leading ceramic manufacturers and a pioneer in the development of strength-enhanced zirconia ceramics. YTZ grinding media, from raw materials to finished product, continues to be thoroughly evaluated from all possible viewpoints with the goal of superior quality.

Ceramic Media Properties

Due to the unique properties of ceramics, YTZ grinding media is resistant to rust and corrosion, and thus compatible with water-based processing. Additionally, YTZ grinding media, produced from yttria-stabilized zirconia “YSZ” powder, exhibits superior grinding efficiency because of higher density, and superior wear resistance due to high crushing strength and fracture durability.

Typical Applications

Through a comprehensive quality system, YTZ grinding media has a solid reputation for the grinding and dispersion of pharmaceutical and foodstuffs as well as those of ultra-fine materials for electronic parts or inks.

- Dielectric, piezoelectric and magnetic materials
- Pigment, inks, dyes, paint and coating materials
- Battery and fluorescent materials
- High purity advanced ceramic materials, frits and glazes
- Pharmaceutical, dental, cosmetics and foodstuffs

YTZ Qualities

YSZ powder used for starting materials is produced by the latest hydrolysis process, known as the “Tosoh process” achieving consistent high quality. YTZ grinding media consists of high purity YSZ absent of any heavy metals. Moreover YTZ grinding media exhibits high wear resistance, which combined with its smooth surface minimizes product contamination from both media and mill wear.

YTZ grinding media, having a narrow size distribution and nearly spherical shape, enables more efficient and precise grinding and dispersion.

YTZ Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Composition</td>
<td>ZrO₂, Y₂O₃</td>
</tr>
<tr>
<td>Specific Density</td>
<td>6.0 g/cm³</td>
</tr>
<tr>
<td>Bending Strength</td>
<td>1200 MPa</td>
</tr>
<tr>
<td>Hardness (Hv10)</td>
<td>1250</td>
</tr>
<tr>
<td>Modulus of Elasticity</td>
<td>210 GPa</td>
</tr>
<tr>
<td>Fracture Toughness</td>
<td>6.0 MPam¹/²</td>
</tr>
</tbody>
</table>

YTZ grinding media consists of extremely uniform fine grains and has virtually no internal defects, resulting in outstanding wear resistance. Significant cost and waste reduction is realized as a result of less media chipping and less frequent media replacement.

Available Sizes

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>Bulk Density (kg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.03</td>
<td>3.5</td>
</tr>
<tr>
<td>0.05</td>
<td>3.55</td>
</tr>
<tr>
<td>0.1</td>
<td>3.7</td>
</tr>
<tr>
<td>0.2</td>
<td>3.7</td>
</tr>
<tr>
<td>0.3</td>
<td>3.9</td>
</tr>
<tr>
<td>0.4</td>
<td>3.9</td>
</tr>
<tr>
<td>0.5</td>
<td>3.9</td>
</tr>
<tr>
<td>0.65</td>
<td>3.8</td>
</tr>
<tr>
<td>0.8</td>
<td>3.8</td>
</tr>
<tr>
<td>1.0</td>
<td>3.8</td>
</tr>
<tr>
<td>1.25</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Grinding Efficiency and Wear Resistance

The test data above is a result of wet milling BaTiO3 powder with a starting surface area of 1.8m²/g. Grinding was conducted with several types of media in a vertical sand mill over a set period of time. As can be seen, YTZ has superior grinding efficiency with the highest wear resistance. The highest surface area of the ground material was achieved with YTZ over the same period of time under identical conditions. This is a clear indication of the high milling efficiency that YTZ provides.

Environment, Safety and Comprehensive Quality System

- YTZ grinding media is produced under a stringent audit system, and has obtained ISO 9001 quality assurance and ISO 14001 environmental management system certifications.
- Traceability

YTZ grinding media can be completely traced from raw materials to the finished products.

YTZ is a registered trademark of Nikkato Corporation in Japan, the United States, and other countries.