MORPHOLOGY OF Z-TECH PLASMA PROCESSED ZIRCONIAS

Z-Tech manufactures a range of high performance monoclinic zirconias utilizing the world's only plasma arc reactor process. The unique particle morphology, imparted by this process provides a level of reactivity that makes these materials desirable in a variety of applications. By examining the following microstructures, one can appreciate the high reactivity and easy milling characteristics of these powders.

Z-Tech's production process involves feeding zircon sand ($ZrSiO_4$) through a high temperature (32,000°F) plasma arc, which melts and dissociates the zircon into its zirconia (ZrO_2) and silica (SiO_2) constituents. The grains are then rapidly cooled as they leave the arc to form spherical agglomerates. Zirconia solidifies first and forms a dendritic structure encapsulated by an amorphous silica. At this point, the dissociated zircon contains approximately 70% ZrO_2 and 30% SiO_2.

The spherical agglomerates are subsequently processed under precisely controlled conditions to remove the silica, which yields a uniformly open crystalline structure. This structure is composed of zirconia crystallites, which are typical 0.2µm in size. The zirconia agglomerates are further processed into grades yielding up to 99.6% purity. The following sequence of scanning electron micrographs shows the morphology of zirconia agglomerates and crystallites. All scales on micrographs are approximates only.

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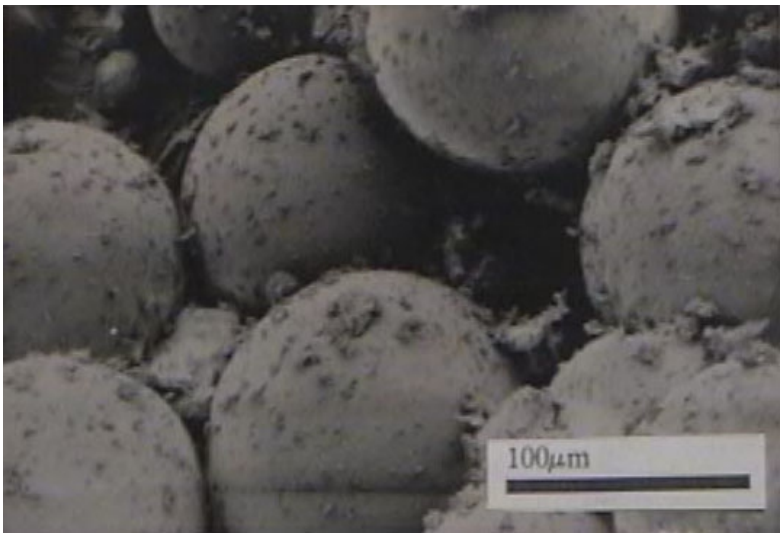

Figure 1: SEM micrograph showing the spherical zirconia agglomerates after removing the silica.

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The surface of these particles exhibit a regular pattern of cracked agglomerates which consist of smaller crystallites. The magnified surface of these particles can be seen in Figure 2 & 3.

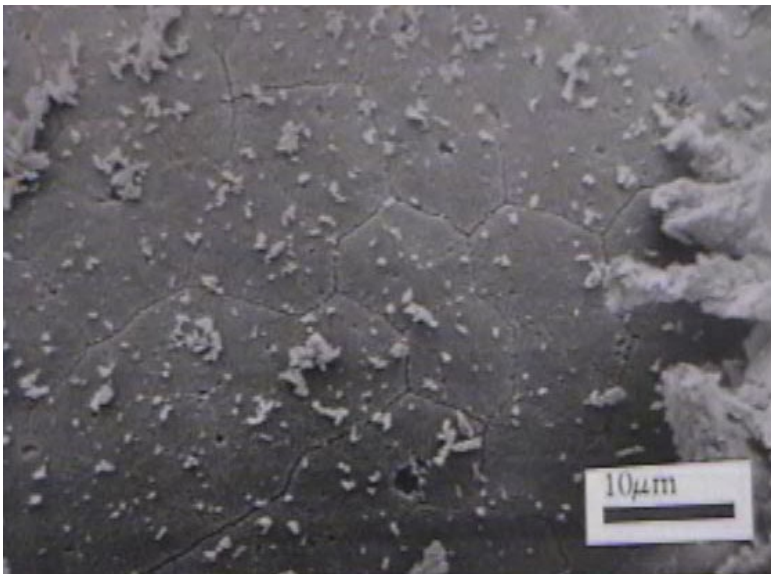

Figure 2: SEM micrograph showing the surface of one spherical zirconia particle shown in Figure 1.

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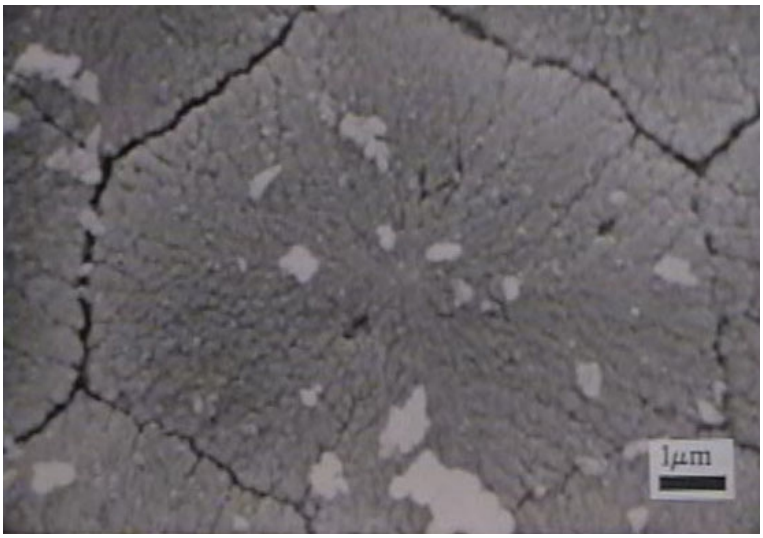

Figure 3: SEM micrograph showing the surface of one spherical zirconia particle shown in Figure 2, but at a higher magnification.

Figure 4 shows the individual zirconia crystallites, which makes up the structure seen in Figure 3. These zirconia crystallites are made up of very small zirconia dendrites.

These dendrites are approximately 0.2μm and can be seen in Figure 5. It is these fine dendrite crystallites that make the zirconia quite reactive, while the weakly bonded open

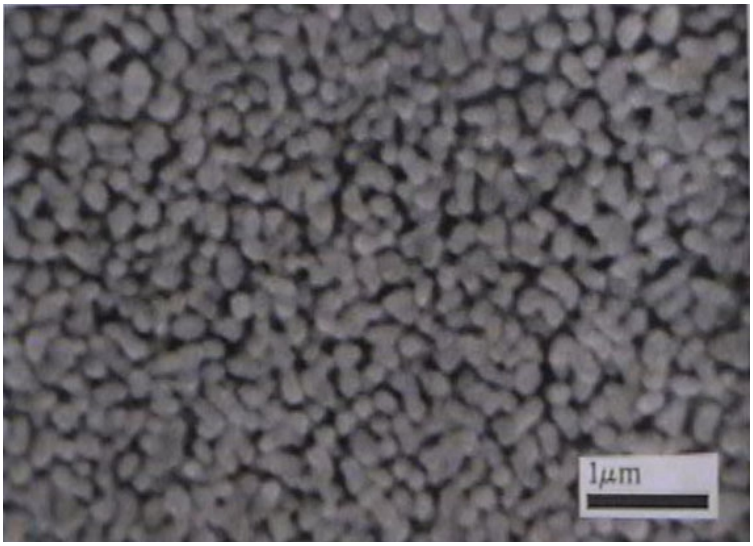

Figure 4: SEM micrograph showing the surface of one spherical zirconia particle shown in Figure 1, but at a higher magnification. Here the uniform individual zirconia crystallites can be seen.

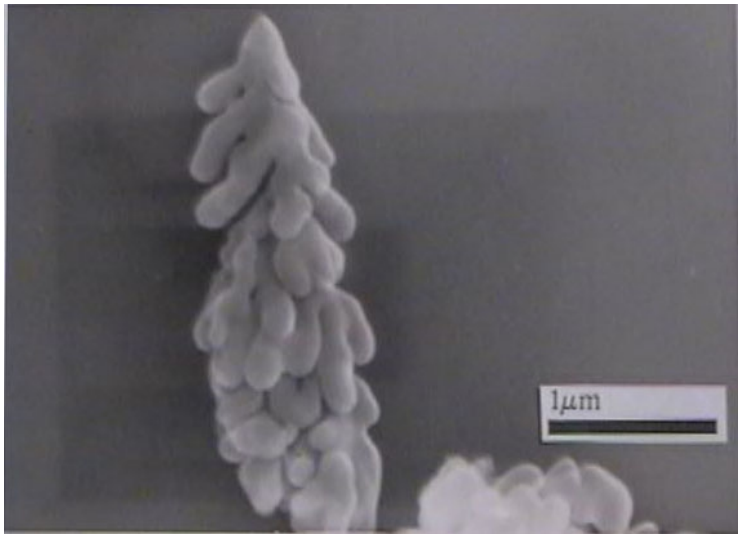

Figure 5: SEM micrograph showing one individual zirconia dendrite crystallite, which makes up the crystallites shown in Figure 4.

structure facilitates easy milling. How these dendrites are arrayed is revealed by the internal cross sectional of a cracked sphere as shown in Figure 6.

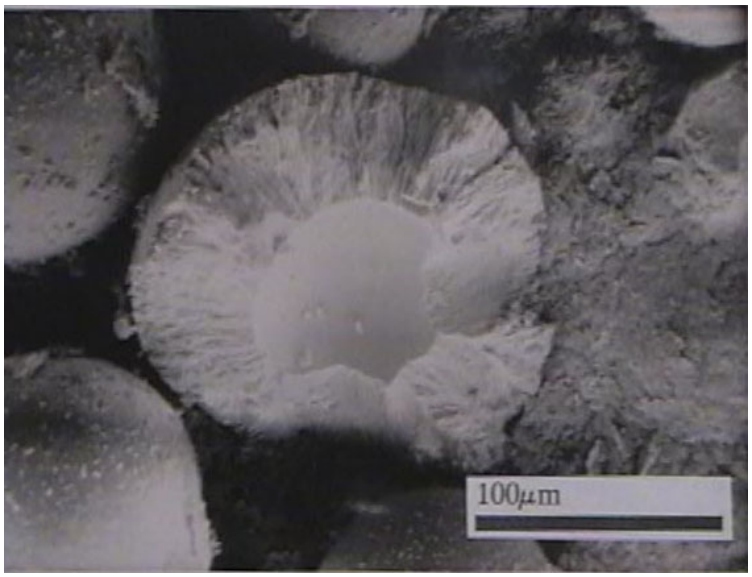

Figure 6: SEM micrograph showing the internal cross sectional microstructure of a cracked sphere seen in Figure 1.

At a higher magnification, the surface clearly shows the zirconia aggregates radiating outward from the center of the sphere. As described in the above microstructures, a higher level of reactivity and performance can be derived from these zirconias.

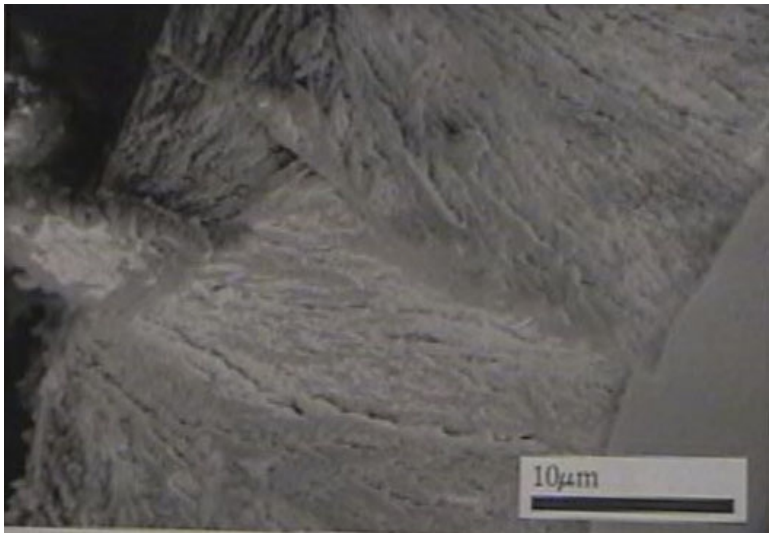

Figure 7: SEM micrograph showing the internal cross sectional microstructure of a cracked sphere as seen in Figure 6, but at a higher magnification.

For further information on Z-Tech's high performance zirconia grades and technical support, please call us at (603) 228-1305. We are very interested in hearing your comments on Z-Tech's zirconias and welcome the opportunity to consult with you on your zirconia needs and application.

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