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Noritake

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ZIRCONIA CRYSTALLISATION

Zirconia is here to stay in dentistry. Since its introduction some two decades ago, the possibilities for use of zirconia have increased enormously. But how is this compound produced? What happens during sintering, what types are available, and how are the desired shape and shade of the final product achieved?

PSZ or Partially Stabilised Zirconia was the first of the zirconium oxides to be used in dentistry. This type of zirconia was stabilised using yttria, and is currently no longer in use. It consisted of a mix of monoclinic, tetragonal and cubic crystals.

For many years, the so-called Y-TZP variety was used (yttria tetragonal stabilised zirconia polycrystal). This has outstanding flexural strength (> 1,000 MPa), however, a non aesthetic opaque white appearance. It consists for mostly of tetragonal crystals with a diameter of some hundreds of nanometres. Approximately 3 mol% yttria is added to keep the material stable at room temperature; this variety is therefore sometimes described as 3Y zirconia.

New varieties, such as cubic zirconia, were developed with the aim of improving the aesthetic properties of the material. Cubic zirconia is characterised by high translucency but has a lower flexural strength. However, although the flexural strength of this type is considerably lower than that of the tetragonal version, it is nevertheless much higher than that of lithium disilicate. This form also contains a higher amount of yttria, ranging from 4 to more than 5 mol%.

CRYSTAL PHASES

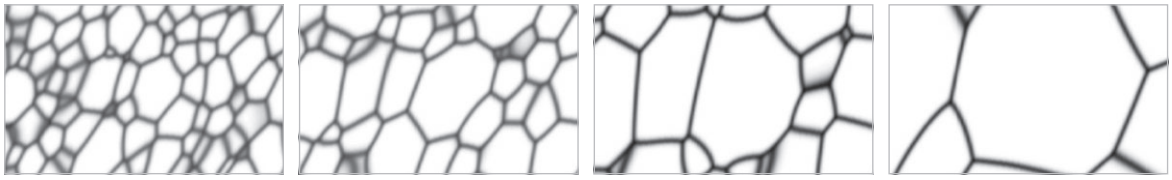
We currently know of zircona crystals in three major shapes.

Monoclinic
Normally, zirconia exists only at room temperature in the monoclinic phase. Monoclinic zirconia has low strength and translucency.

Tetragonal
These zirconia crystals are metastable and only exist at room temperature after stabilisation, mainly by adding yttria. Although tetragonal zirconia is strong, it has limited aesthetic properties.

Cubic
Cubic crystals are stable and provide improved translucency. Due to the addition of a higher percentage of yttria, cubic zirconia work pieces are not as strong as tetragonal ones. On the other hand, they are highly aesthetic and therefore suitable for monolithic restorations, even in the anterior zone.

CRYSTALLISATION PROCESS
Zircona is almost invariably offered as a partially sintered material. In this form it is always opaque white, and the true colour and translucency is only apparent after sintering. During sintering, the material shrinks to its ultimate size; a multitude of small crystals merg to form larger crystals, but although the crystals themselves increase in size, the total volume decreases. This shrink factor is therefore taken into account in the software, so that the end product is not only colourfast after sintering, but is also sizewise correct.



Small crystals merge into larger ones during the sintering process.

KATANA™ Multilayer HTML before (left) and after sintering.

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