

Cubic Zirconia (stabilised zirconium oxide)

by Mike Richardson

This rather wonderful synthetic is much sneered at, mainly because it is relatively cheap and common. Whilst it makes a very good diamond simulant, it is a beautiful stone in its own right because of its high refractive index, 2.16, which gives it a real sparkle.

It is hard, at 8.5, only a little softer than corundum and very heavy, SG up to 6, so you do not get a very big piece for your money. However, as I mentioned, it is cheap. Dispersion is higher than diamonds'

0.044 at up to 0.065, so with the exception of rarity, it more than fulfils all the requirements of a true gemstone.

With a single exception it is accepted that this material is not known to occur in nature. A single find of a zirconia crystal inside a zircon crystal may or may not change this view. (Vargas). I have not found a reference to clarify whether this crystal was monoclinic or cubic. If the latter, it would require a freak of nature to add the required stabiliser.

Cubic zirconia (CZ) is manufactured by melting zirconium oxide powder in a skull crucible at temperatures above 2000° C. This temperature is too high for normal refractory crucibles; the skull crucible is made of vertical, water cooling pipes which form the outside of the crucible surrounded by an induction heating coil. Induction heating requires the material to be conductive, zirconium oxide is only conductive at high temperatures so a starter is provided in the form of a piece of zirconium metal which eventually forms part of the melt. The cooling water pipes keep a crust formed around the outside (the skull) with the molten material in the centre. Normally zirconium oxide is only cubic in its molten state. On cooling and crystallising, it becomes monoclinic and opaque. To maintain the cubic and transparent form, a stabiliser is added to the melt. The stabiliser can consist of magnesium, calcium or yttrium oxide; the properties of the CZ vary according to the stabiliser used. Unstabilised opaque zirconium oxide is produced as a high temperature refractory material. (Peter G Read).

The melt is cooled slowly by reducing the electric current in the heating coils and is held at 1400° C for 12 hours to anneal the crystals. The crystals form as interlocked, twisted columns and are broken out of the skull.

Just about any colour, including colour change, can be produced by adding appropriate elements including 'rare earths' to the melt.

CZ is not particularly difficult to cut and polish; it is listed as grade 1 along with the other common competition cutting materials. It does however present a few issues which the cutter needs to take into account.

It can be brittle, especially if the annealing process has been hurried or gone wrong which is often the case when 'bargain material' is offered. This brittleness can cause chipping on sharp edges such as keels and acute girdle angles as can be found for instance on trillions and marquise shapes.

The solution is to position the stone, or if you can, change the lap direction so that you are cutting towards the edge. Of course changing to a finer lap will also help.

CZ often displays directional properties. This is very apparent in the finer stages of cutting. Sometimes, if you keep the stone in one place on the lap, the facet will polish rather than cut. Simply move your mast so that you can swing the stone across the lap thereby changing the cutting direction or reverse the direction of rotation if your machine has this facility. Because of its hardness and high melting temperature, CZ needs to be polished

with diamond. On larger stones I use 3K Voodoo followed by 14K or 50K on the same corian lap with the finer grade on the outside. This is contrary to normal practice with other diamond compounds.

Whatever method you normally use to polish corundum successfully will work equally well on CZ.

Photo 1 A selection of replica diamonds in CZ from the author's collection.



Photo 2 A selection of CZ from the author's own collection.



Photo 3 (Right) Tiffany Yellow cut from CZ

Photo 4 (Below) A Skull Crucible Gem Photos by Brian McCarthy, others from the web.

(Right) Tiffany Yellow cut from CZ



Skull Crucible

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