ZIRCON IS NOT ZIRCONIA

The discrimination of colourless stones and their classification can be cause of much confusion, especially when they are facetted in the brilliant cut. After carrying out Rapid Tests at the SSEF Laboratory, we often have to clear up a misconception, namely the confusion between zirconia and zircon or synthetic diamond. Some people even think that they have come across "brilliants with an emerald cut"! You probably have a better insight. In that case I apologise for the following detailed explanations. But there may be others. And for the latter I have set up this short paper to shed some light on the problem.

Diamond is the form of carbon crystallising in the cubic system. Carbon can also occur in other solid forms such as, for example soot, graphite and lonsdaleite. The formation and crystallisation of natural (i.e. "genuine") diamonds can be as old as 3000 million years and were formed at a depth of about 130 km in the melt of the upper mantle of the earth crust. Nowadays, diamonds can be formed from dissolved carbon in the laboratory, and the results are artificial products called synthetic diamonds. Both natural and synthetic diamonds possess identical or very similar physical properties:

Diamond (natural and synthetic)	Hardness 10
Refractive index n = 2.42	Density 3.52 g/cm^3

Synthetic diamonds used in modern jewellery most probably could only consist in small yellow stones (synthetic canaries, see figure, small stone left side). The distinction between these and natural coloured diamonds is possible in the gemmological laboratory.

The term "brilliant" on its own and with no other additional information denotes, according to the CIBJO rules, diamonds with the round brilliant cut.

Thus, the material (diamond) and the cut (round brilliant) are defining the expression. Should one of these two conditions not apply, then supplementary information must be provided:

For different shapes	e.g. oval diamond, modified brilliant cut
For different material	e.g. topaz with a brilliant cut, zirconia (artificial product) with a brilliant cut

In the retail trade the term "diamond brilliants" should be used because omission of the word "diamond" can result in much confusion, as the relationship between diamond and brilliant is not always apparent to layment.

It is now clear that the "brilliant with an emerald cut" means, in fact, a diamond with an emerald cut. The commonly-used expression "emerald cut" should be more precisely stated. As emeralds can be cut in different shapes and styles, it would be much less confusing to say a "diamond with an octagonal step cut".

Zircon (Zirconium silicate, $ZrSiO_4$) is a natural, tetragonally crystallising mineral occurring colourless, yellow, orange, brown, reddish and green. Heat treatment can sometimes change coloured zircons to blue or colourl stones. The radiation emitted by trace amounts of radioactive elemer (mainly uranium and thorium) cause a progressive inner destructi (metamictisation) of the crystal lattice, the extent of which depends on t type and amount of radioactive elements present, as well as on the durati of radiation. Due to this, zircons can change with time and this is reflected their varying physical properties:

High Zircon (intact Zircon)	Low Zircon (crystal lattice damaged by irradiation)
high physical values	low physical values
double refraction n_o 1.94 n_e 2.01	single refraction n 1.78
density 4.7 g/cm^3	density 4.0 g/cm^3

A complete series exists between the two extreme types of zircon (high low). Colourless, heat-treated zircon used to be the classic replacement the more expensive diamond.

Zirconia (zirconium dioxide, ZrO_2) is a trade name for an artificial produ used in imitating diamonds. Calcium or yttrium is added to zirconiu dioxide and the resulting material is crystallising in the cubic system. Due this, the material exhibits no double refraction (no birefringence) and th more closely resembles diamond. Omission of Ca or Y would lead to crystallisation of ZrO_2 in the monoclinic system (with birefringence). For t reason zirconia is often known as "cubic stabilised zirconium dioxide". Ap from the name "zirconia", the names djevalite, fianite and others are a used on occasion. The synthetic production of zirconia is undertaken by t skullmelting process. The physical properties of zirconia are:

Zirconia n 2.17, density 5.65 (Ca) and 5.95 (Y) g/m^3 respectively
hardness 8.5, relatively brittle

Colourless zirconia represents the most common diamond simul encountered today. Zirconia with faint yellow colour is also used in colo master series for the colour-grading of diamonds. Since recent tim zirconia can be obtained in virtually any colour, e.g. red, orange, yell green, blue and violet. These colours are obtained by the addition of vario trace elements.

The sole common feature of zircon and zirconia is the chemical elem zirconium which occurs in both substances and explains the similarity in t nomenclature of the two materials.

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From left to right: Diamonds (natural and synthetic), zircons (natural stones) with various colours, and zirconias (artificial products) with various colours