Corundum

Corundum belongs to the mineral class of oxides and hydroxides. It is the α-modification of aluminum oxide with the molecular formula Al_2O_3. In nature, corundum is a common by-product in aluminum-rich Magmatites and metamorphic rocks and occurs as a gemstone in the form of the color varieties sapphire and ruby.

Due to its characteristic properties, such as its high hardness (Mohs 9; see also: Mohs hardness), its chemical and physical resistance and its significant thermal conductivity with simultaneous electrical insulation, (technical) corundum is the most frequently used industrial mineral worldwide.

The following synthetic corundum can be obtained via different manufacturing processes:

- *White high-grade corundum consists of more than 99% Al_2O_3. It is colorless with the stain color white. The transparency (refractive index: nε = 1.759 to 1.763) is described as translucent to transparent.*

- *Brown normal corundum has an Al_2O_3 content of between 94% and 96%. Compared to white corundum, normal corundum is less pure and has a titanium oxide content of more than 2%, which affects the color and toughness.*

- *Semi-precious corundum is a mixture of precious and standard corundum with a total content of approx. 97% Al_2O_3.*

- *Pink high grade corundum gets its characteristic color by adding 0.2% chromium(III) oxide during production.*

- *Ruby corundum is produced by adding 2% chromium(III) oxide in the production process.*

White High-Grade Corundum

All corundum types are based on bauxite as raw material. This ore consists of various aluminum- and iron-containing oxides and hydroxides, kaolinite and, to a lesser extent, anatase, a modification of titanium dioxide.

In order to obtain normal corundum, bauxite is converted to the desired material in a reduction reaction using iron filings and coke in an electric arc furnace (approx. 2120 °C). In this process, iron is removed from the starting material, making it the main component of the ferrosilicon by-product.

To synthesize white aluminium oxide, bauxite is first chemically separated using the Bayer process. The resulting intermediate product, aluminium hydroxide (gibbsite), is further processed into pure aluminium oxide by calcination. In the temperature spectrum, the aluminum oxide undergoes various (metastable) modifications, above all γ-Al2O3 (gamma alumina with cubic spinel structure), in order to be irreversibly converted into the thermally stable α-Al2O3 (alpha alumina, rhombohedral/trigonal corundum structure). In the final step, this so-called “calcined alumina” is melted in an electric arc furnace to form precious corundum.

The resulting melt cake is crushed and screened according to the grain sizes specified in the relevant DIN standards. (See: FEPA; See: Grain sizes).

Alumina itself is also needed for certain applications or as a starting material in aluminum production. This aluminum oxide is porous and has a large reactive surface.