# Ceramic Magnets

Ceramic magnets are also known as hard ferrites or ferrite magnets, which are composed of primarily iron oxide, $Fe_2O_3$. The two common compositions are: strontium ferrite, $SrFe_{12}O_{19}$ ($SrO{\cdot}6Fe_2O_3$) and barium ferrite $BaFe_{12}O_{19}$ ($BaO{\cdot}6Fe_2O_3$).

Ceramic magnets were developed in the 1950s. Although their maximum energy product, $(BH)_{max}$, is lower than other permanent magnets, Ceramic magnets have found many applications. In fact, the world still uses more ceramic magnets than any other type of permanent magnets today when measured by weight.

Ceramic magnets have the following characteristics:

1. Least expensive magnets due to inexpensive raw materials and processes;
2. Chemically very stable;
3. Maximum energy product, $(BH)_{max}$, of 1 to 4 MGOe, which is lower than that of Alnico and rare earth magnets;
4. Intrinsic coercivity, $H_{ci}$, from 2500 to 4000 Oersteds, which is higher that of Alnico magnets but much lower than rare earth magnets;
5. Very high electrical resistivity (around $10^6$ Ohm-cm);
6. Positive reversible temperature coefficient of intrinsic coercivity;

Ceramic magnets can be either isotropic or anisotropic. Isotropic ceramic magnets can be magnetized in any direction while the anisotropic ceramic magnets can only be magnetized through the easy axis (magnetization direction).

Ceramic magnets have good resistance to demagnetization, excellent thermal stability, and superior corrosion resistance. They are an excellent choice, because of low cost and abundance of raw materials, for many applications including loudspeakers, DC motors, magnetic separators, sensors, reed switches, and holding devices.