Samarium Cobalt Magnets

There are two families of Sm-Co magnets -- $SmCo_5$ and Sm_2Co_{17}. EEC Ultra High temperature magnets belong to the Sm_2Co_{17} family.

$SmCo_5$ Magnets

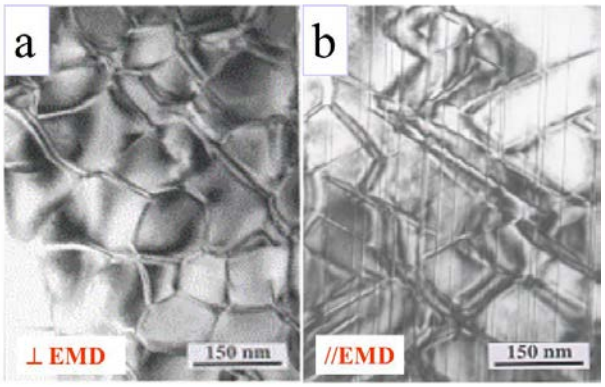
$SmCo_5$ was developed in the late 1960s and early 1970s. It consists of five atoms of cobalt for each samarium atom with a hexagonal crystal structure. $SmCo_5$ magnets are also known as $RECo_5$, Sm-Co 1:5, samarium cobalt 1:5 magnets, SmCo series 1:5 magnets, or sometimes simply 1:5 magnets.

$SmCo_5$ has a very high intrinsic coercivity, H_{ci}, which is a measurement of resistance to demagnetization. Its maximum energy product, $(BH)_{max}$, is about 20 MGOe. The reversible temperature coefficient of residual induction of $SmCo_5$ is about -0.04%/°C. Heavy rare earth elements, such as Gd, Tb, Ho and Er, are sometimes substituted for a portion of the Sm to reduce the reversible temperature coefficient of residual induction.

$SmCo_5$ has very good corrosion resistance and long-term thermal stability. No surface coating is necessary. $SmCo_5$ can be used at temperatures up to 300°C.

Sm_2Co_{17} Magnets

Sm_2Co_{17} was developed in the 1970s. It has a rhombhedral crystal structure, which is obtained by replacing 1/3 of the Sm atoms in the $SmCo_5$ hexagonal structure with a pair of Co atoms known as dumbbells. Commercial Sm_2Co_{17} magnets contain other elements such as iron, copper and zirconium. The partial replacement of cobalt with iron helps increase the saturation magnetization, while the addition of copper and zirconium is critical for the formation of cellular microstructure (see figures below) for the development of high intrinsic coercivity.



Cellular microstructure of Sm_2Co_{17} type magnets

Sm_2Co_{17} is also know as RE_2TM_{17}, Sm-Co 2:17, SmCo Series 2:17, $Sm(Co,Fe,Cu,Zr)_z$ or sometimes simply 2:17 magnets.

Sm_2Co_{17} magnets have very high intrinsic coercivity with maximum energy product $(BH)_{max}$ as high as 33 MGOe. Sm_2Co_{17} magnets can be used at temperatures up to 300°C. The reversible temperature coefficient of residual induction is about -0.035%/°C. Like $SmCo_5$ magnets, heavy rare earth elements can be substituted for a portion of the Sm in order to reduce the reversible temperature coefficient of residual induction for $Sm(Co,Fe,Cu,Zr)_z$ magnets.

Applications of Sm-Co Magnets

Sm-Co magnets are the ultimate choice for high speed motor applications due to their high resistance to demagnetization and excellent thermal stability at elevated temperatures.

Sm-Co magnets also have excellent corrosion resistance. It is not necessary to have surface coatings for most applications. It is highly desirable for demanding medical applications because of their superior corrosion resistance and thermal stability, especially when autoclave sterilization is needed for medical instruments such as surgical tools.

Temperature compensated Sm-Co magnets are also the first choice for inertial devices such as gyroscopes and accelerometers, and traveling wave tubes (TWTs) due to their small reversible temperature coefficient of residual induction and excellent high temperature stability.