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Presentation Title

Replacement and Original Magnet Engineering Options

Abstract

Permanent magnets based on rare earths (REs), in particular the neodymium-iron-boron (Nd-Fe-B) type, have revolutionized the worlds of computing, motors/actuators and electrical/electronic devices. Furthermore, they are increasingly important in environmentally critical technologies like hybrid and pure electric vehicles (HEVs and EVs) as well as for wind turbines.

Suggestions will be given on how to drastically reduce or totally eliminate the need to use scarce and most expensive heavy rare earths (HREs) like terbium (Tb) and dysprosium (Dy, which are indispensable in high coercivity, high temperature applications and represent by far the highest expense in production of Nd-Fe-B magnets: neodymium (340\$/kg), dysprosium (2950\$/kg) and terbium (4300\$/kg). All prices as of 4 Nov 2011 for RE metal 99% min.

A typical magnet for automotive or moderately high-temperature use employs about 30-24 weight percent Nd and 4–10 weight percent Dy or Tb, i.e.,  $Dy/Nd = 0.2$ . Therefore the real problem in terms of critical supply lies in the heavy rare earths, rather than REs in general. It will be presented how these heavy rare earths can be reduced or even totally eliminated by advanced synthesis, characterization and modeling focused on grain boundary engineering, introducing modified grain boundaries and sophisticated control of the microstructure towards the nanoscale, as one of the possible solutions.

The other idea, which will be briefly presented and showed more in details by other experts is focused on new permanent magnets with no rare earth.

The new materials will be based on breakthrough ideas, innovative technologies and alternative materials rather than access to scarce or highly overpriced raw materials.