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Presentation Title

Rare Elements in Magnetic Materials

Abstract

Magnetic materials will be classified into spintronic materials, hard magnetic materials and soft magnetic materials. Especially, rare elements (noble metals and rare earth metals) are used in former two groups. Examples of these materials are summarized and some efforts to replace rare elements with others and/or to make rare elements free materials will be explained.

Spintronics materials

It is well known that both GMR (Giant Magnetoresistance) effect and TMR (Tunnel Magnetoresistance) effect contributed to the increase of recording density of DRAM and the realization of magnetoresistive memory MRAM. Especially, much interest is focused on high density MRAM in order to realize so-called Normally-off-Computer. The key technology is how develop a magnetic tunnel junction (MTJ) with high thermal stability and low energy consumption. In order to fabricate such MTJs, the importance of materials will be explained. We are searching noble-metal-free or rare earth-free junction materials. Our recent results will be introduced.

Hard magnetic materials

NdFeB permanent magnet is one of the important materials for recent advanced technological industry. In order to increase the thermal stability of the magnet property, a relatively large amount Nd is replaced by Dy. Due to the anti-parallel coupling of the magnetic moment of Dy with that of Fe, the energy product reduces. In addition, the natural supply of Dy is limited and it's cost increases remarkably in recently. Dy-free or Dy-lean NdFeB magnets are strongly desired. Kato group (Yamagata University) is carrying out very attractive methods for this issues. I introduce their recent results.

Finally, the various methods to replace rare elements will be summarized.