MAR12-2011-006394

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

**High-Performance Permanent Magnets for Energy-Efficient Devices**

GEORGE HADJIPANAYIS, Department of Physics and Astronomy, University of Delaware, Newark, DE, U.S.A.

Permanent magnets (PMs) are indispensable for many commercial applications including the electric, electronic and automobile industries, communications, information technologies and automatic control engineering. In most of these applications, an increase in the magnetic energy density of the PM, usually presented via the maximum energy product $(BH)_{max}$, immediately increases the efficiency of the whole device and makes it smaller and lighter. Worldwide demand for high performance permanent magnets has increased dramatically in the past few years driven by hybrid and electric cars, wind turbines and other power generation systems. New energy challenges in the world require devices with higher energy efficiency and minimum environmental impact. The potential of 3d-4f compounds which revolutionized the PM science and technology is almost fully utilized, and the supply of 4f rare earth elements does not seem to be much longer assured. This talk will address the major principles guiding the development of PMs and overview state-of-the-art theoretical and experimental research. Recent progress in the development of nanocomposite PMs, consisting of a fine (at the scale of the magnetic exchange length) mixture of phases with high magnetization and large magnetic hardness will be discussed. Fabrication of such PMs is currently the most promising way to boost the $(BH)_{max}$, while simultaneously decreasing, at least partially, the reliance on the rare earth elements. Special attention will be paid to the impact which the next-generation high-$(BH)_{max}$ magnets is expected to have on existing and proposed energy-saving technologies.