ΣΕΜΙΝΑΡΙΟ

Advanced Permanent Magnets: Current Status and Future Prospects

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Αίθουσα συνεδριάσεων
και τηλεδιασκέψεων
του Τμήματος Φυσικής
4ος όροφος

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Abstract

Permanent magnets (PMs) are indispensable for the electric, electronic and automobile industries, information technologies, automatic control engineering and many other commercial and military applications. 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 PMs has increased substantially in the past few years driven by hybrid and electric cars, wind turbines and other power generation systems. A dramatic improvement in the performance of PMs was made during the 20th century, with $(BH)_{max}$ increased by more than 100 times, as a result of major advances in solid state physics, materials science and metallurgy. However, 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 lecture will cover the major principles guiding the development of PMs, including the important role of microstructure on coercivity, 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 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. Current efforts in the development of high performance non-rare earth magnets and their future prospects will also be discussed.