Séminaire de l'Institut d'Electronique Fondamentale

Mardi 18 décembre 2012 à 14h

Centre scientifique d'Orsay - Bât. 220 – Salle Pierre Grivet (pièce 44 – RdC) – *F 91405 ORSAY*

attention : jour et heure inhabituels !!!

Science and Technology of Modern Permanent Magnet Materials

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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 that revolutionized PM science and technology is nearly fully utilized, and the supply of 4f rare earth elements is no 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.

Biography - George Hadjipanayis received the B.Sc. degree in Physics from the University of Athens (1969), and the M.Sc. and Ph.D. degrees in Physics from the University of Manitoba (Canada), in 1974 and 1979, respectively. Prof. Hadjipanayis was an assistant professor (1982-1985) and associate professor (1986-1988) in the Department of Physics at Kansas State University. In 1989 he joined the faculty of the University of Delaware as a full professor. In 1998, Prof. Hadjipanayis was a Humboldt Senior Fellow at the Max Planck institute (Stuttgart, Germany). In 1999, he assumed the position of Richard B. Murray Distinguished Professor of Physics and Astronomy and since 2003 has been the Chair of the Department of Physics and Astronomy at the University of Delaware. He has been recognized for seminal advances in scholarship with the Francis Alison Award (2005) and by elevation to Fellow of the American Physical Society (2001). Prof. Hadjipanayis' areas of interest span hard magnetic materials with a focus on high performance permanent magnets and magnetic nanoparticles for storage media and biomedical applications. He has published more than 500 technical articles in peer-reviewed science and engineering journals, including book chapters, review articles, and invited technical feature articles on the topical areas of rare earth magnetism, nanotechnology, and permanent magnet materials, among others.

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