Professor Bogdan IDZIKOWSKI
Institute of Molecular Physics
Polish Academy of Sciences (IFM PAN)
M. Smoluchowskiego 17, 60-179 Poznań, Poland

Specialization: solid state physics, magnetism, nanotechnology

Main topics: structure/properties relations in metallic structurally metastable systems, magnetism and relaxations processes in small particles systems, magnetism of soft magnetic nanocrystalline alloys, magnetic and transport properties of rare earth-transition metal compounds, magnetism of nanoluminescence materials.

Professor Lotfi BESSAIS
Institut de Chimie et des Matériaux de Paris Est (ICMPE), Univ Paris Est Creteil, CNRS, ICMPE, UMR 7182, 2 Rue H. Dunant, F-94320, Thiais, France

Specialization: solid state physics, permanent magnets, nanostructured materials, magnetocalorics, magnetic refrigeration

Main topics: structure properties of metallic systems, magnetism of intermetallic compounds, magnetic behaviour of small particles systems (superparamagnetism), electronic structure, hyperfine parameters, hard/soft magnetic materials, magnetocaloric effects.

Collaborative project:

Properties of new hard magnetic compounds and composites with reduced rare earth content

Fe-based permanent magnet material (rare earth free or with reduced content of critical elements) will be synthesized by melting of pure elements. Formation of desired $ThMn_{12}$ phase (and also other intermetallic compounds: 1:5, 2:17) will be also controlled by further treatment: thermal and/or mechanical (plastic deformation). Optimal stoichiometry will be chosen to maximize magnetocrystalline anisotropy, energy product and Curie temperature. It is expected that the alloys will be characterized by high thermal stability and also high Curie temperature, exceeding that of commonly used Nd-Fe-B magnets. We intend to reduce the amount of critical elements in the group of alloys crystallizing in 1:12 structure. Our systems will be based on transition metals (Fe, Ni, Co) and cheaper substitutions (*e.g.* Ce, Zr, Al, Si, B, Ti) of critical elements (like Nd). Magnetic characteristics of 1:12 phases strongly depend on the minor substitutions on both rare earth and transition metal sites. Theoretically, $NdFe_{12}N$ is predicted to be the highest performance permanent magnet in this group. For structurally metastable 1:12 phase is expected energy product equals to 686 kJ/m^3. In turn, theoretically determined values for Ce-based alloys are more than half of that of Nd-based and the energy product is equal to 396 kJ/m^3 for $CeFe_{11}Ti$. Concluding, 1:12 alloys containing of Sm or Ce would not reach the energy product of Nd-based alloys but should ensure advantageous performance *vs.* cost ratio.