National Institute of R&D for Technical Physics – IFT Iasi
http://www.phys-iasi.ro
Main activities and results in Micro- and Nanoscience (1)

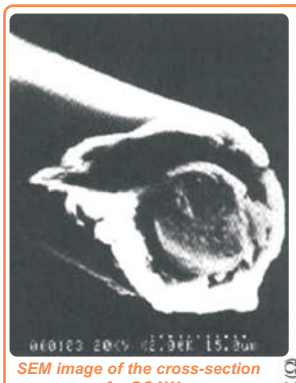
The National Institute of R&D for Technical Physics (NIRDTP) – IFT Iasi is part of the network of national institutes coordinated by the Ministry of Education and Research (MER) - National Authority for Scientific Research (ANCS).
Founded in the late 1960s, IFT Iasi is engaged in top-notch basic and applied research in the area of magnetism and magnetic materials. In 2000, the institute raced fellow research entities for the Center of Excellence status and was declared so by MER in recognition of its outstanding results in the research of magnetism, magnetic materials, and their applications.

IFT Iasi conducts RD&I activities along three main directions:

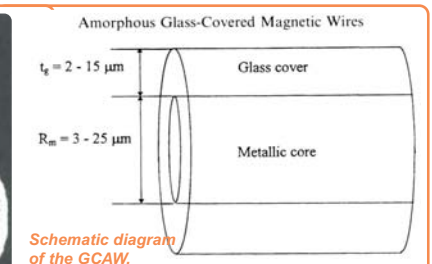
- **fundamental research:** new models, new phenomena, and theoretical aspects;
- **applied research:** new materials, applications, and R&D equipment;
- **theoretical research:** novel technologies for the manufacturing of new materials, devices, and technological equipment; and
- **small–scale manufacturing materials, devices, systems, and equipments for lab research and production activity.**

These activities are reflected in those over 500 papers published in prestigious international journals, most of them listed in the ISI database, 4 international patents and 50 national ones, and more than 70 homologated new products and technologies.

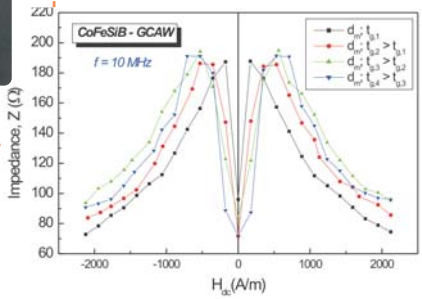
The key RD&I activities developed by the **Magnetic Materials and Devices Department** from IFT Iasi in the field of micro and nanotechnologies, are based mainly on preparation, characterization and applications of advanced materials with specific structures and properties.



SEM image of the cross-section of a GCAW.



Schematic diagram of the GCAW.



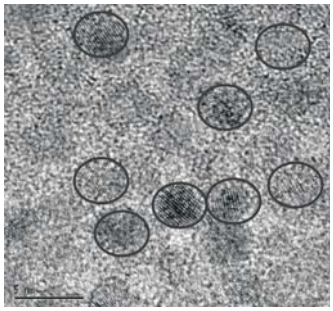
GMI effect obtained for a CoFeSiB GCAW .

The results, published mainly in international scientific journals and communicated at prestigious conferences in the field, are nationally and internationally recognized as top ones:

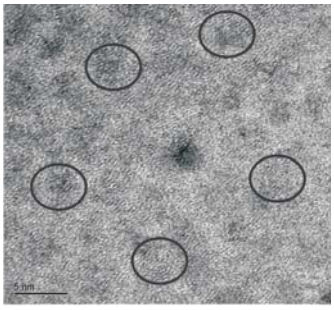
• different types of glass-covered amorphous (GCAW) microwires: FeSiB positive magnetostrictive GCAW, CoSiB negative magnetostrictive GCAW, CoFeSiB nearly zero magnetostrictive GCAW;

The glass-covered magnetic amorphous and nanocrystalline microwires exhibit very specific behavior, like the giant magnetoimpedance (GMI) effect, large gyromagnetic effect (LGE), Magnetostrictive Delay Line (MDL) effect, which is the base the operating principles for different sensors, actuators and transducers based on GCAW: magnetic field sensors; vibrating sensors; position sensors; displacement sensors; torque sensors; stress sensors; NDT sensors; electronic surveillance labels / tags; safety systems; fluxgate sensors. The obtained results have been communicated at international scientific conferences and workshops (65), published in scientific ISI journals (59), and patented nationally (1 patent) and internationally (1 patent in USA, 2 patents in Europe, and 1 patent in Canada)

• high-coercivity bulk amorphous alloys under the shape of thick melt-spun ribbons, bars, cylinders, or discs obtained in Nd-Fe-(Al,Si) systems, with very specific structures (discontinuous nanosized structural/magnetic structures (clusters). Complex theoretic (phenomenological models) and experimental studies to evidence the specific structural and magnetic features have been performed. The main results have been communicated at national and international scientific conferences and workshops (31), and published in ISI scientific journals (20);

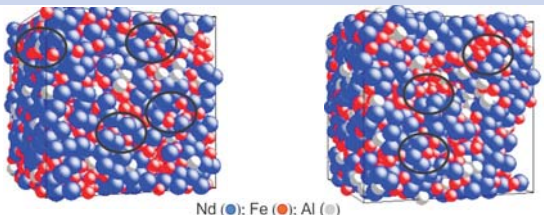


Melt-spun ribbons 25 μm thick

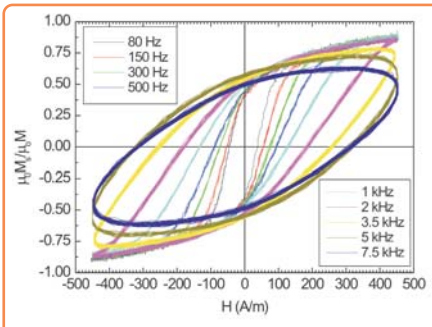


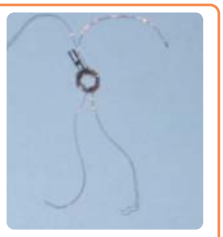
Melt-spun ribbons 120 μm thick

HRTEM images (left) and modeled Reverse Monte Carlo (RMC) structures (right) (the experimental results have been obtained by neutron diffraction at Studsvik NFL, Sweden) reveals clearly 2–3 nanometer size clusters embedded in the amorphous matrix.



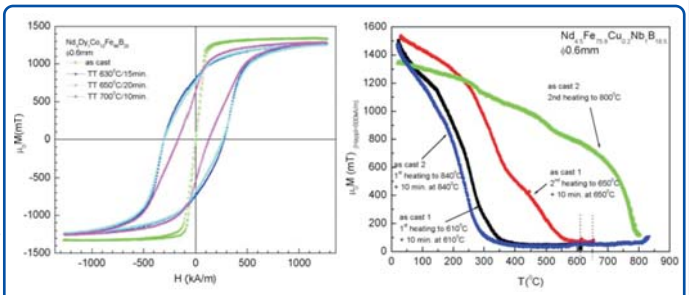
Melt-spun ribbons 25 μm thick — Melt-spun ribbons 120 μm thick





FeCoNiNbB torroidal shape bulk sample (right) and the variation of the magnetic properties with the frequency for the same sample (left).

• new amorphous FeZrB-based and nanocomposite FeNbB-based bulk shaped soft magnets as torroids and cast bars prepared by die-casting technique, specially designed for applications (miniaturized transformers and converters). *The optimization of the softness of the as-prepared bulk alloys has been achieved by tailoring the composition, preparation conditions and samples dimensions.*



Magnetic hysteresis loops for NdFeB based rod samples in as-cast and devitrification annealed states (left); thermomagnetic curves for rod samples (right).

• new NdFeB based bulk shaped permanent magnets with additions (bars, cylinders, tubes, other 3-D shapes) prepared by slow cooling of the melt in Cu moulds using vacuum suction and injection casting techniques. *The optimization of the permanent magnet characteristics has been achieved by complex studies, involving both theoretical models and compositional and microstructural design studies. The results have been communicated at national and international scientific conferences and workshops (10) and published in ISI scientific journals (5).*