NANOSTRUCTURED MAGNETIC MATERIALS Lab

PhD Positions at nM^2-Lab
2023

Position 1

Investigation of magnetic and morpho-structural properties of sustainable permanent magnets

Place: Un. Roma Tre & CNR - Institute of Structure of Matter (Roma, Italy)
Call deadline: 27.06.2023
Web site: https://scienze.uniroma3.it/en/research/phds/phd-programme-in-condensed-matter-physics-nanoscience-and-complex-systems/
Contacts: info@nm2lab.com

Permanent magnets are fundamental components in a wide variety of applications ranging from energy conversion devices to household appliances and rapidly developing green technologies (e.g. hybrid vehicles, wind turbines). Current high-performance magnets owe their extraordinary properties to the presence of rare earth elements, which are currently considered highly critical elements due to supply issues and the high environmental impact associated with extraction/processing. In response to these issues, it is necessary to develop effective solutions that reduce the demand and use of rare earths, including the optimization of existing materials, the development of new hard magnetic phases, and the recycling/reuse of end-of-life magnets.
Within this context, the present project aims to thoroughly investigate the correlation between magnetic and morpho-structural properties of sustainable permanent magnets, both sintered and bonded (prepared by 3D printing), obtained from recycled magnets containing rare earths or from nanopowders of hard/soft coupled systems based on hexaferrites with a zero or reduced content of critical elements. To this end, techniques of structural and morphological characterization, magnetometric investigations, and numerical simulations will be employed to study how material properties, such as composition, crystallographic structure, particle/grain size, magnetic characteristics, and degree of alignment, influence final performance.

Position 2

Sustainable design of new permanent magnets

Place: University of Genova, Dept. of Chemistry and Industrial Chemistry (Genova, Italy)
Call deadline: 10.07.23
Web site: https://unige.it/en/students/phd-programmes
Contacts: info@nm2lab.com

Permanent magnets are fundamental components in a wide variety of primary applications ranging from energy-conversion devices, household appliances, to rapidly developing green technologies (i.e., hybrid vehicles, wind turbines). Current high-performance permanent magnets owe their extraordinary properties to the presence of rare-earth elements, whose mining and refining

processes require large amounts of energy and water, while generating vast volumes of CO_2 emissions as well as pollutants and radioactive secondary materials. The present PhD project is mainly aimed at developing innovative and sustainable design of new permanent magnets to face the rare-earth element criticality issue. Rare-earth-free hard/soft exchange coupled nanocomposite powders containing $BaFe_{12}O_{19}$ hexaferrites as the hard phase and $CoFe_2O_4$ spinels or FeCo as the softer phase will be synthesized by ball milling and/or chemical approaches, to manufacture mid-range PMs filling the gap between HFs and RE-PMs.

Position 3

Study and development of magnetic nanoparticles and PDMS based electrospun membranes

Place: University of Genova, Dept. of Chemistry and Industrial Chemistry (Genova, Italy)
Call deadline: 10.07.23
Web site: https://unige.it/en/students/phd-programmes
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The PhD project includes the study of a polymer-based hybrid nanocomposite material, in which nanoparticles with magnetic properties of different compositions are dispersed. The hybrid material is processed using the electrospinning technique, which allows the production of fibrous fabrics. The fibers have dimensions ranging between micrometres and nanometres, endowing the material with high porosity, high surface area, and mechanical resistance features. Depending on the final composition of the hybrid material, it is possible to foresee uses in the bio-technological and bio-medical sectors, in line with the "Health" theme of the PNRR.

N.B.: shared position with the group *www.ne2lab.unige.it*