Open PostDoc Position

"Designing the Next-Generation of rare-earth-free Permanent Magnets"

Context

Fe_2P is a particularly intriguing binary compound that has been intensively studied over the past two decades for its unique first-order magneto-elastic transition, which gives rise to giant magnetocaloric effects [Nature 415(2002)150 ; Adv. Mater. 26(2014)2671]. Fe_2P is also one of the transition-metal–based compounds with the largest magnetocrystalline anisotropy. Recent investigations have shown that subtle chemical substitutions can yield a promising combination of large magnetization, high Curie temperature, and strong anisotropy, making Fe_2P-based compounds attractive as permanent magnets [Acta Mater. 221 (2021) 117388]. This renewed interest has raised numerous questions on structure–property relationships in general, and on the origin of anisotropy in particular.

Project

The objective of this project is to develop a fundamental understanding of phase formation, magnetic structures, and physical properties in ternary and quaternary compounds derived from Fe_2P, with the ultimate goal of establishing guidelines for designing new permanent magnets. The research will be primarily experimental, involving sample synthesis (solid-state reaction and single-crystal growth) followed by systematic structural and physical-properties characterizations. The project will also include active participation in large-scale facility experiments (neutron diffraction, x-ray absorption).

Understanding the mechanisms by which alloying affects magnetic properties and anisotropy is expected to have a broad impact, not only for permanent magnets but also for magnetocaloric applications of this materials family. In addition, this work should open new pathways toward designing intermetallic compounds with promising intrinsic magnetic properties.

This position will also provide opportunities for the candidate to develop his research project in condensed matter physics and magnetic materials, benefiting from the extensive facilities available at the CRISMAT.

Candidate Profile:

We are seeking a highly motivated and talented experimentalist with a PhD in Materials Science, Physics, Chemistry, or a related field. Prior experience in one or more of the following areas will be considered an asset: intermetallic synthesis, microscopy, x-ray diffraction, and/or magnetic measurements.

Practical details

Location : CRISMAT, Caen, France. https://crismat.cnrs.fr/

Funding: 24 months, funded by the Normandy Region ("Objectif Labels d'excellence" project). Gross salary: ~3000 € / month. . Starting End 2025-Early 2026.

Application: Candidates are invited to submit their CV (including publications list and research interests), PhD diploma, and cover letter to francois.guillou@unicaen.fr.

Application Deadline: 3rd October 2025. We encourage early applications. Shortlisted candidates will be contacted for an on-line interview.

Open PostDoc Position

"Optimizing the functionality of Fe_2P compounds through microstructural control"

Context

Fe_2P-type compounds form a rich materials family that has been intensively studied over the past two decades for their unique first-order magnetic transition, which gives rise to giant magnetocaloric effects [Nature 415(2002)150 ; Adv. Mater. 26(2014)2671]. These compounds crystallize in a hexagonal quasi-2D structure with non-equivalent metallic layers stacked along the *c*-axis, leading to a strong uniaxial magneto-crystalline anisotropy. Recent investigations have shown that subtle chemical compounding can yield a promising combination of intrinsic properties —saturation magnetization, Curie temperature, and anisotropy— making Fe_2P-based systems attractive candidates for permanent magnet applications [Acta Mater. 221(2021)117388].

Project

The main goal of this project is to transform anisotropy into coercivity by designing optimized microstructures, ultimately providing a proof-of-concept for a Fe_2P-based permanent magnet. The research will be primarily experimental, with potential support from micromagnetic and finite elements modeling. The candidate will focus on improving coercivity by optimizing synthesis methods, which currently involve ball-milling and solid-state reactions. Unconventional sintering approaches —such as hot forging using Spark Plasma Sintering— will be investigated. The project will include systematic structural, microstructural, and physical property characterizations to correlate processing routes with performances.

Progress in densification, texturing, phase formation, and defect engineering in Fe_2P compounds is expected to have broader impact, not only for permanent magnets but also for magnetocaloric applications. In particular, how the microstructure can influence the development magneto-elastic phase transitions across finite-size samples should be explored.

This position will also provide opportunities for the candidate to develop his research project in condensed matter physics and magnetic materials, based on the extensive facilities available at the CRISMAT.

Candidate Profile:

We are seeking a highly motivated and talented experimentalist with a PhD in Materials Science, Physics, Chemistry, or a related field. Prior experience in one or more of the following areas will be considered an asset: intermetallic synthesis, microscopy, X-ray diffraction techniques and/or magnetic measurements.

Practical details

Location : CRISMAT, Caen, France. https://crismat.cnrs.fr/

Funding: This position is funded for 18 months by the Agence Nationale de la Recherche under the France 2030 programme (ANR-23-EXES-0001 CaeSAR). Gross salary: ~3200 € / month. Starting January 2026.

Application: Interested candidates are invited to submit their CV (with publications list and research interests), PhD diploma and cover letter to francois.guillou@unicaen.fr.

Application Deadline: 3rd October 2025. We encourage early applications. Shortlisted candidates will be contacted for an on-line interview.