PROJECT FACTSHEET

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CO-FERMAT

Coupling in Multifunctional ferroic materials

Inspiration

The origin and understanding of coupling phenomena between different physical properties is a central subject of solid state science and related applications. It has fascinated physicists, chemists and materials scientists for decades and is becoming increasingly important for multifunctional materials. A large amount of research currently concentrates on multifunctional materials in which several functions can be used simultaneously.
One of the key questions for the future development of multifunctional or smart materials concerns the mutual coupling between the properties, its underlying mechanism and whether it can be used in applications. Multiferroics are multifunctional materials par excellence, because they simultaneously possess several so-called ferroic orders such as ferromagnetism, ferroelectricity or ferroelasticity. The prefix ferro refers historically to iron (ferrum in Latin), which shows a spontaneous magnetization M that can be controlled (and critically reversed) by the application of a magnetic field. In analogy, the electrical polarization P of a ferroelectric material can be controlled by the application of an electric field, and the ferroelastic deformation e by a mechanical strain. The understanding of cross-coupling between ferroic orders and external parameters presents both profound fundamental questions and great potential for innovative applications.

Innovation

The overall objective of the CO-FERMAT project is to acquire a broad knowledge of coupling phenomena in multiferroic materials with the aim of discovering new general concepts, clearing the way for both understanding and applications. For this, we intend to embrace the whole range from fundamental research to industrial collaborations.
The field of (multi)ferroic materials is extremely active with a great number of research axes. We believe devoutly that only a broad approach and thus a profound knowledge of ferroic materials will allow both a fundamental understanding and innovative applications. Within this broad approach we will focus our main efforts on four lines of research, which are introduced below. Depending on the line of research, our research will have a more application-related focus with a public-private-partnership or be more at the forefront of science in emerging fields such as domain engineering.

- Piezoelectric materials (coupling of deformation & ferroelectricity)
- Magnetoelectric Multiferroics (coupling of electric & magnetic orders)
- Photoferroelectrics / Photoferroics (coupling of light with ferroic orders)
- Domain Boundary engineering (multiple coupling)

Impact

This PEARL project is integrated into the Materials Research and Technology (MRT) department of the Luxembourg Institute of Science and Technology (LIST). The project has high strategic value for LIST with the aim of reinforcing the field of high knowledge-content materials, which will provide new functionalities and improved performance and which will be critical drivers of innovation in technologies.

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