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Hysteresis Design of Magnetic Materials for Efficient Energy Conversion

Tuesday, 10 December 2024, 9:00 s.t., TU Darmstadt L2|01 228 and via Zoom



Prof. Dr. Victorino Franco
Condensed Matter Physics
Department, Universidad de Sevilla

Zoom information:
Meeting-ID: 688 0734 0972
Kenncode: 841621

Hysteresis and Reversibility of Magnetocaloric Materials: A Chase after Applicability

Abstract:

The eventual implementation of magnetocaloric temperature control systems as a replacement of less environmentally friendly devices in sectors ranging from home appliances to gas liquefaction requires detailed knowledge of the thermomagnetic response of the phase transformations that take place during device operation, with a significant focus on hysteresis and reversibility. Despite this requirement, materials are usually characterized under experimental conditions that do not resemble those of the device for which they are supposedly designed: quasistatic instead of dynamic; complete transformations instead of partial transformations; single-shot operation instead of cyclic. These approximations simplify the way in which materials are characterized, but complicate the predictability of the actual performance of the material in real devices.

In this talk, we will focus on two aspects of this research endeavor: On the one hand, we will present the physics behind the recently proposed Temperature-First-Order-Reversal-Curves (TFORC) technique for magnetocaloric materials, its use to identify detailed information of phase transitions, and its suitability for the prediction of the thermomagnetic response of a material in arbitrary conditions. On the other hand, we will highlight the potential of high entropy alloys for magnetic refrigeration, focusing on a combination of a targeted property search and materials processing.

About the speaker:

Victorino Franco is a professor at the Condensed Matter Physics Department of the University of Seville, Spain. His main research interests cover magnetic materials for energy applications, including soft-magnetic, magnetocaloric materials and functional high entropy alloys. He has published more than 230 peer-reviewed technical articles and received more than 13,600 citations to his work. In 2000, he received the Young Scientist Award from the Royal Physical Society of Spain, followed by the Young Scientist Award of the Royal Order of Chivalry of Seville in 2005. He has served as chair of the Spanish Club of Magnetism (CEMAG), of the Spain Chapter of the IEEE Magnetics Society, and of the Magnetic Materials Committee of the Minerals, Metals & Materials Society (TMS). He has been general chair for the 23rd Soft Magnetic Materials Conference and of the 2022 Joint MMM-Intermag Conference. He currently serves as a scientific manager in the area of functional materials for the Spanish State Research Agency (AEI). He became Fellow of IEEE in 2024 and the TMS held the honorary symposium "Advanced Soft Magnets and Magnetocaloric Materials: An FMD Symposium Honoring Victorino Franco" in Orlando in 2024.

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