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## Hysteresis Design of Magnetic Materials for Efficient Energy Conversion

**Tuesday, 16 July 2024, 16:00 s.t., TUDa, via Zoom**


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**Ames National Laboratory of US Department of Energy, Iowa, USA**


Zoom information:
Meeting-ID: 622 2024 3184
Kenncode: 644285

## Magnetic behavior of rare earth intermetallic compounds


**Abstract:**

The rare earth intermetallic compounds are famous for their unconventional and technologically relevant magnetic properties. Of note are hysteresis phenomena, which may be either helpful (high performance permanent magnets) or harmful (solid state caloric cooling). In this talk we will explore R2In compounds (R = Pr, Nd, and Eu), known for their an-hysteretic magnetic first-order transformations, and discuss possible origins of the observed behavior.1-4 The influence of applied magnetic field on the first-order nature of the transition in Eu2In was examined by the heat-capacity and magnetization measurements showing good agreement with earlier published mean-field modeling results.5 Then we will analyze the relations between rare earth and transition metal compounds sharing the same crystal structure aiming to comprehend why their corresponding magnetic ordering phase transformations chose very different pathways depending on the presence or absence of f-electrons. Finally, we will talk about how progress in our basic understanding of these transitions can lead to a breakthrough in the design of materials for caloric heat pumping technology.



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1. F. Guillou et al. “Non-hysteretic first-order phase transition with large latent heat and giant low-field magnetocaloric effect”, Nature Communications 9, 2925 (2018).
2. A. Biswas et al., “First-order magnetic phase transition in Pr2In with negligible thermomagnetic hysteresis”, Physical Review B 101, 224402 (2020).
3. W. Liu et al., “Large magnetic entropy change in Nd2In near the boiling temperature of natural gas”, Applied Physics Letters 119, 022408 (2021).
4. W. Cui et al., “Unconventional metamagnetic phase transition in R2In (R=Nd, Pr) with lamda-like specific heat and nonhysteresis”, Journal of Materials Science & Technology 101, 80 (2022).
5. B. P. Alho et al., “Free-energy analysis of the nonhysteretic first-order phase transition of Eu2In”, Physical Review B 102, 134425 (2020).


**About the speaker:**

Yaroslav Mudryk received his M.S. degree in Chemistry (1997) and his Ph.D. in Inorganic Chemistry (2002) from Ivan Franko National University in Lviv, Ukraine. He joined Ames National Laboratory as a post-doctoral associate in 2004 and became a staff scientist at the laboratory in 2005, working closely with Karl A. Gschneidner, Jr. and Vitalij K. Pecharsky. He is a group leader at the Division of Materials Science and Engineering and is involved in both basic and applied research. Yaroslav’s research, presented in over 180 peer-reviewed publications, focuses on structure-property-relationships in rare earth-based intermetallic compounds and materials for magnetic refrigeration. The areas of his expertise include experimental synthesis and characterization of rare earth intermetallic alloys and compounds and science of coupled magnetic and structural solid-state transformations that respond strongly to external stimuli.