Oral | Applications: Motors and others

Tue. Jul 29, 2025 10:45 AM - 12:15 PM JST | Tue. Jul 29, 2025 1:45 AM - 3:15 AM UTC Convention Hall(300, 3F)

[O6] Applications

Session Chair: Dr. Yusuke Hirayama(National Institute of Advanced Industrial Science and Technology)

Invited

11:55 AM - 12:15 PM JST | 2:55 AM - 3:15 AM UTC

[O6-5] Magnetic Refrigeration from Ambient Temperature to Hydrogen Liquefaction: bringing a technology to the market

*Konstantin P Skokov[1], Wei Liu[1], Alex Aubert[1], Falk Münch[2], Dimitry Benke[2], Tino Gottschall[2,3], Max Fries[2], Oliver Gutfleisch[1] (1. Technische Universität Darmstadt (Germany), 2. Magnotherm Solutions GmbH (Germany), 3. Helmholtz-Zentrum Dresden-Rossendorf (Germany))

Keywords：Magnetocaloric materials、Magnetic refrigeration、Magnetic system

---

The magnetic refrigeration technology with enhanced energy efficiency, improved safety and better environmental sustainability has emerged as a viable alternative to conventional gas-compression refrigeration. This talk provides an overview of our recent advances in developing and optimizing magnetocaloric materials for applications in refrigerators operating at ambient temperatures and for cryogenic conditions (hydrogen liquefaction). We elucidate our trajectory from laboratory research to industrial implementation of the various classes of magnetocaloric materials (rare-earth (R) metals and alloys such as Gd and $La(FeSi)_{13}$, Heusler alloys, Laves phases such as RCo_2, R_2In, etc.). Key issues to be discussed include achieving maximum adiabatic temperature change and isothermal magnetic entropy change, reducing thermal hysteresis in materials first-order magneto-structural transitions, enhancing thermal conductivity and corrosion resistance, and improving durability and scalability [1-5]. The talk will also introduce the first commercially available permanent magnet-based drink cooler Polaris with 85 W and the supermarket display cooler Eclipse with 1 kW cooling power.

1. W. Liu et al., A matter of performance and criticality: A review of rare-earth-based magnetocaloric intermetallic compounds for hydrogen liquefaction. *J. Alloys Compd.* **995**, (2024) 174612
2. W. Liu et al., Designing magnetocaloric materials for hydrogen liquefaction with light rare-earth Laves phases. *J. Phys. Energy* **5**, (2023) 034001 (2023)
3. K. P. Skokov et al, A multi-stage, first-order phase transition in LaFe11.8Si1.2: Interplay between the structural, magnetic, and electronic degrees of freedom. *Appl. Phys. Rev.* (2023) **10**, (2023) 031408
4. N. Weiß et al, Stable Operation of Copper-Protected La(FeMnSi)13Hy Regenerators in a Magnetic Cooling Unit, ACS Applied Engineering Materials 3 (2025) 2565.
5. https://magnotherm.com/