01.04.2025

Magnetocaloric Materials for Hydrogen Liquefaction

HySchool Days 2025

Topical Area #3 – Storage and distribution

Vilde Gahr Sturtzel Lunde
PhD Candidate at Institute for **Energy** Technology (IFE)

Supervisors: Bjørn Christian Hauback (IFE), Christoph Frommen (IFE), Anja Sjåstad Olavsen (UiO)

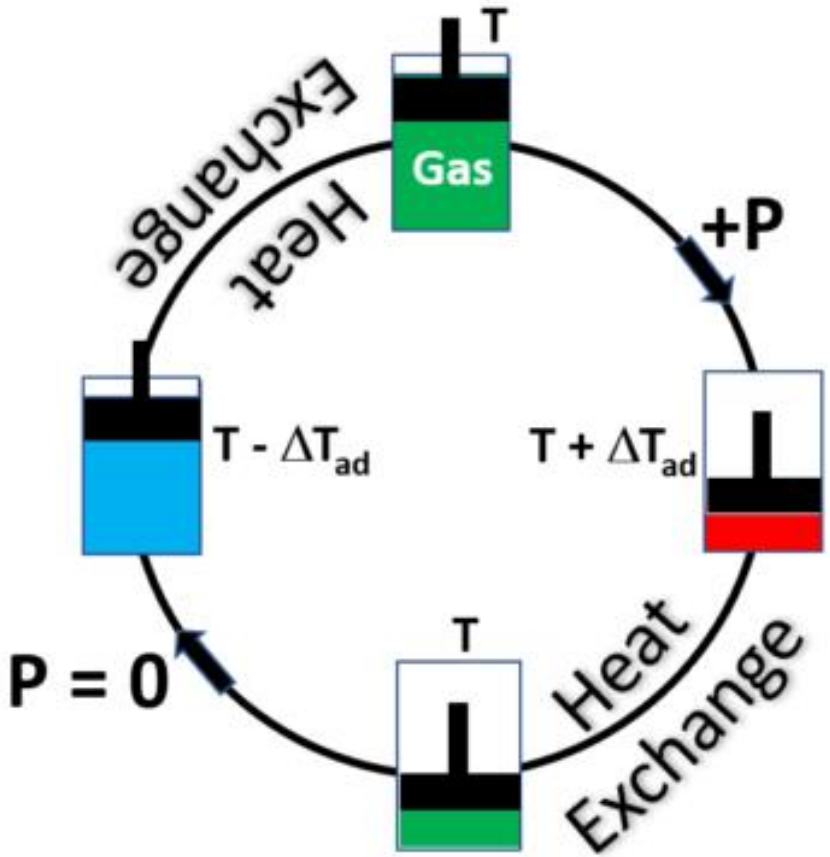
Project: *LIQUID-H:* Hydrogen Liquefaction with Caloric Materials

Why *Liquid* Hydrogen?

https://www.altinget.no/artikkel/pionerskip-klar-for-daap

Challenges of Conventional Hydrogen Liquefaction

https://www.airliquide.com/



Gas compression-expansion cycle

P pressure

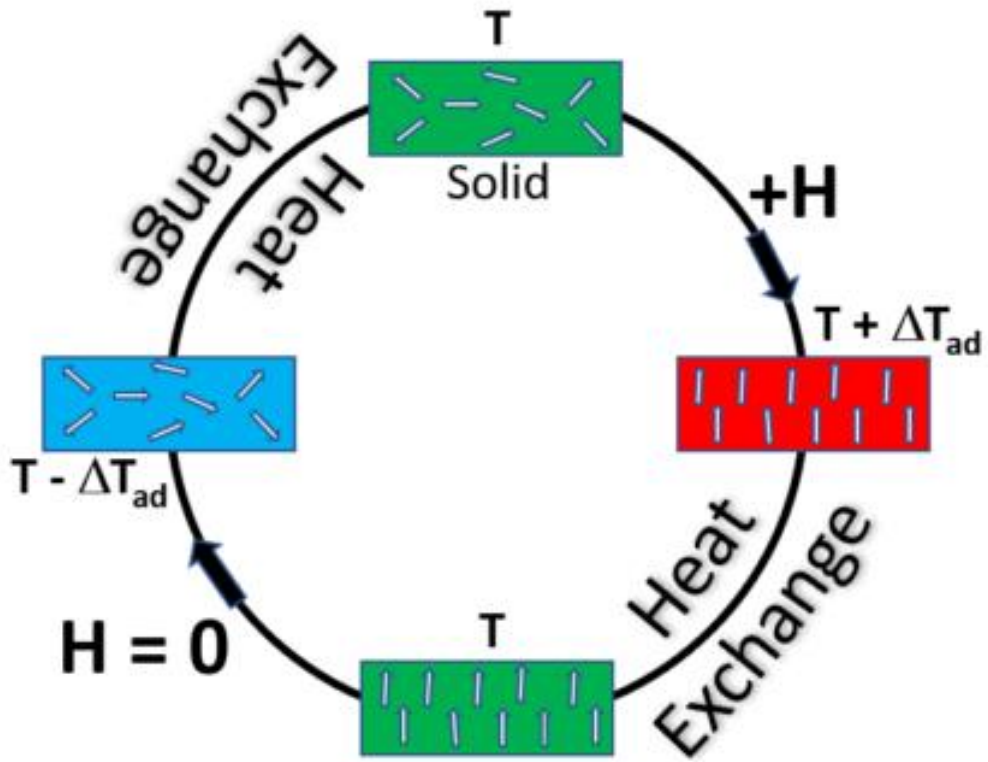
H magnetic field

T temperature

hot

ambient

cold



Magnetic refrigeration cycle

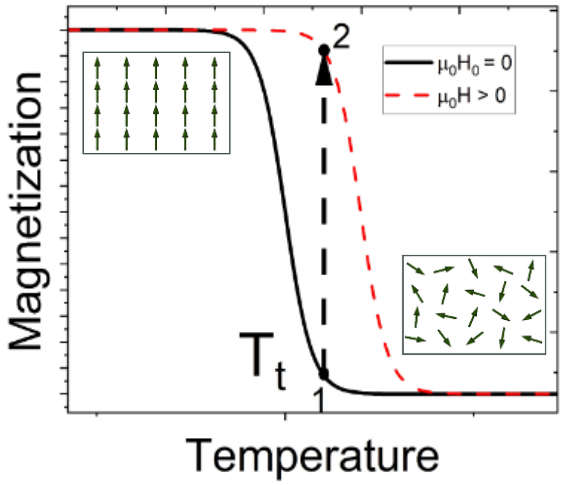
Figure made by Christoph Frommen

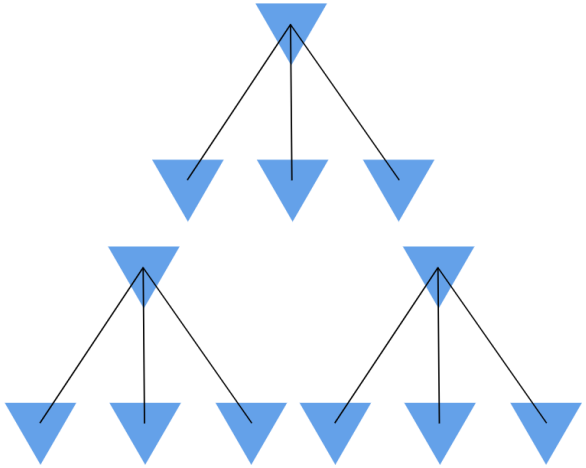
Applications of Magnetocaloric Cooling

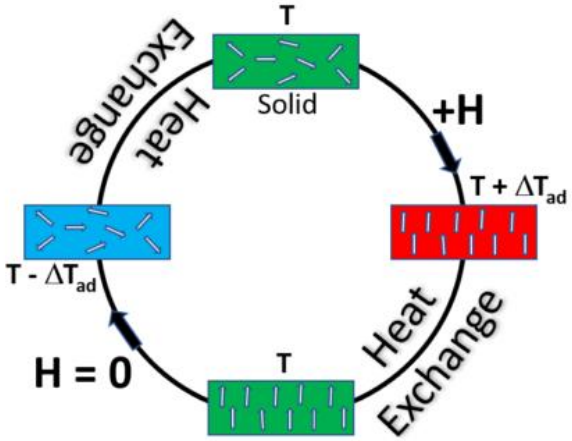
https://www.coolingpost.com/world-news/debut-for-magnetic-refrigeration-wine-cooler

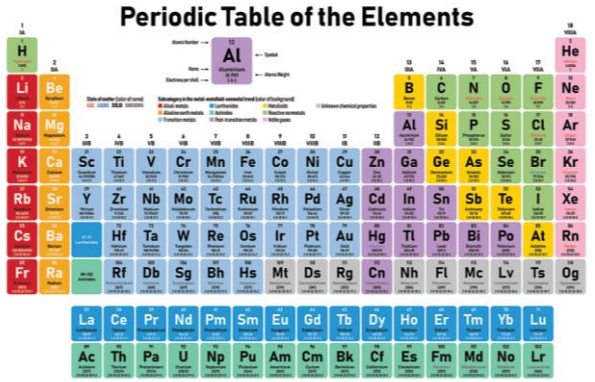
https://www.magnotherm.com

My PhD Project









Magnetic transition temperature between 20 and 77 K (-253 to -196 °C)

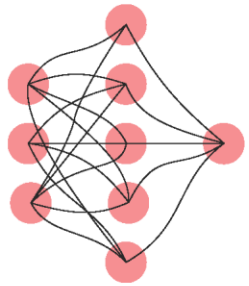
Predict candidates using machine learning models

High magnetocaloric effect and cooling efficiency

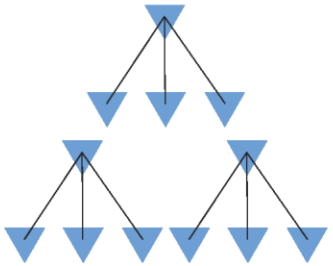
Reduce the amount of critical raw materials

Machine Learning Guided Discovery of Light Rare Earth Laves Phases for Megnetocaloric Hydrogen Liquefaction

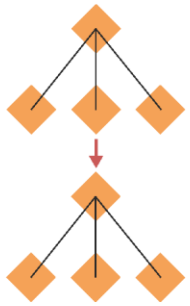
Prediction of Curie temperature using three different machine learning models



Neural Network

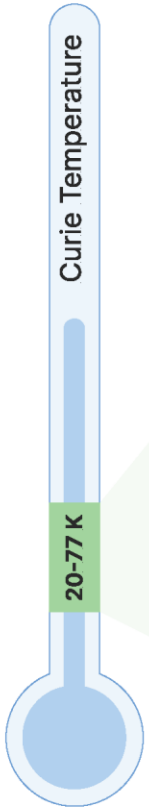


Random Forest

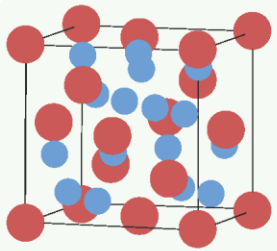


Gradient Boosting

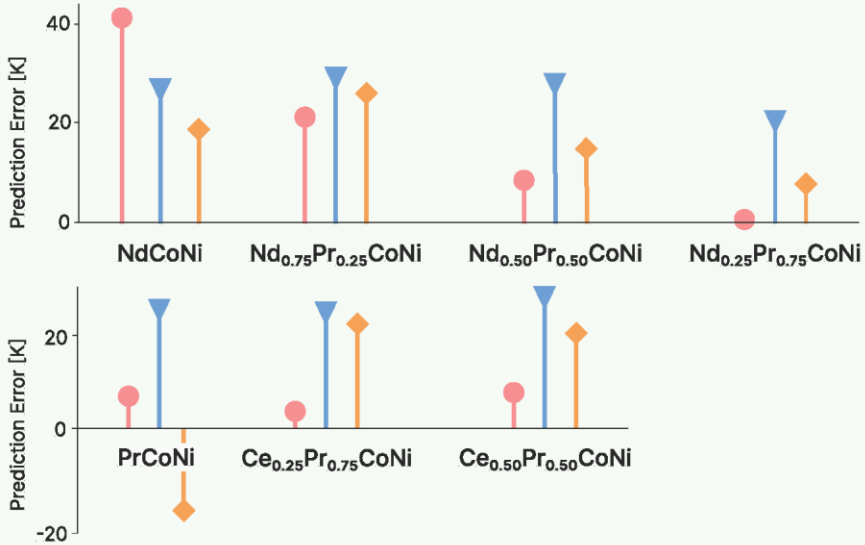
MAE	20 K	14 K	18 K



Synthesis and characterization of promising compounds

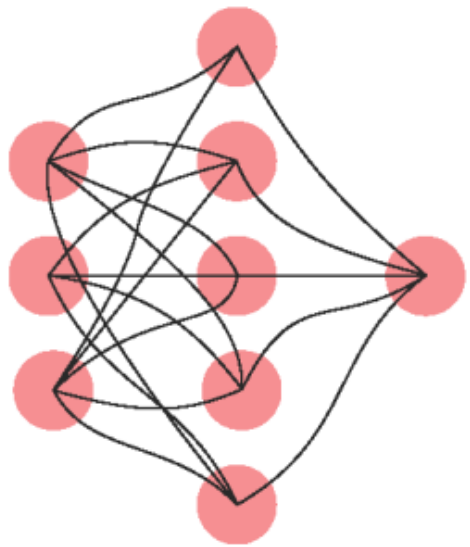


Cubic Laves

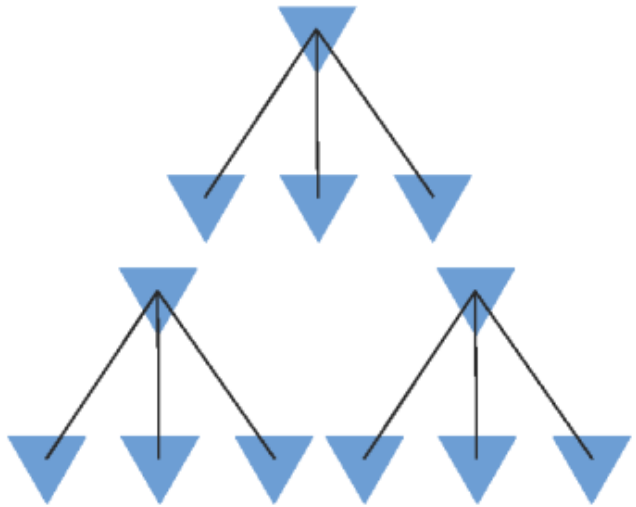


Verification of predicted Curie temperatures and magnetocaloric effect

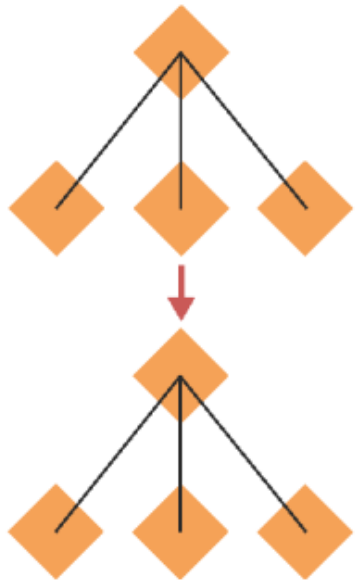
Prediction of Curie temperature using three different machine learning models



Neural Network



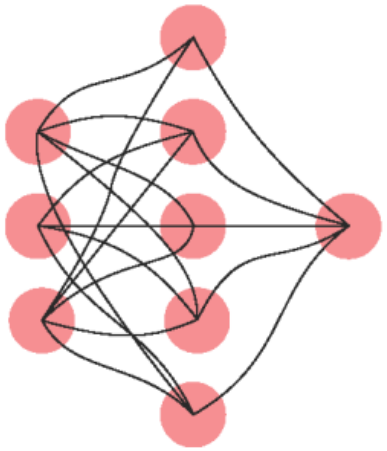
Random Forest



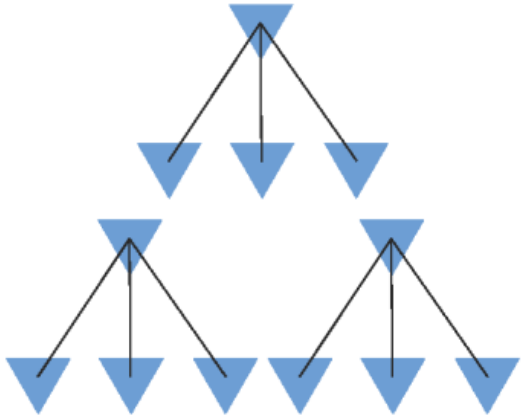
Gradient Boosting

MAE	20 K	14 K	18 K

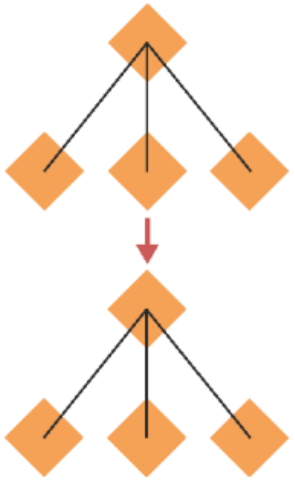
Prediction of Curie temperature using three different machine learning models



Neural Network

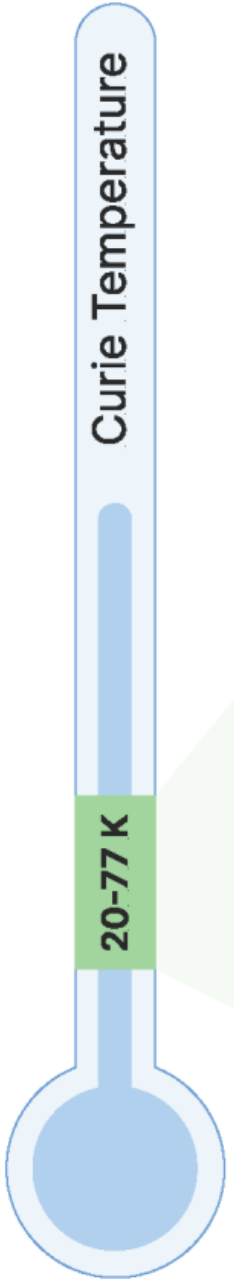


Random Forest

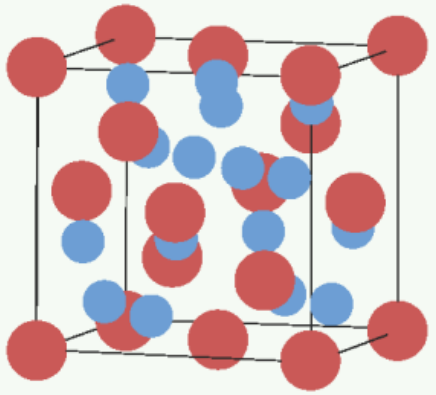


Gradient Boosting

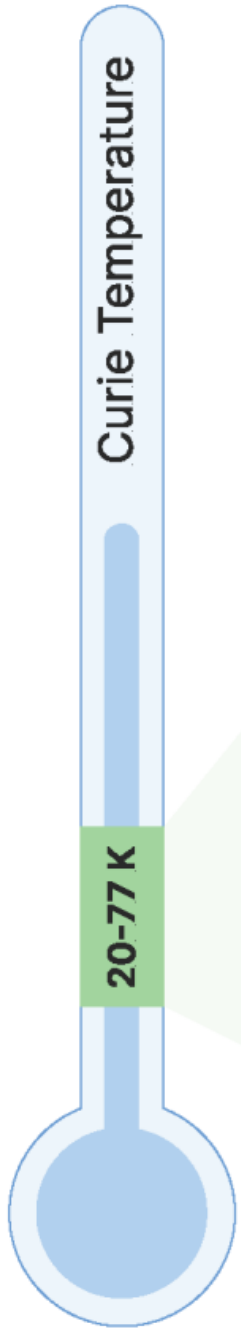
MAE	20 K	14 K	18 K



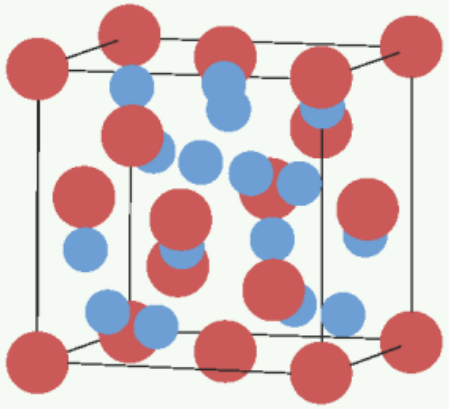
Synthesis and characterization of promising compounds



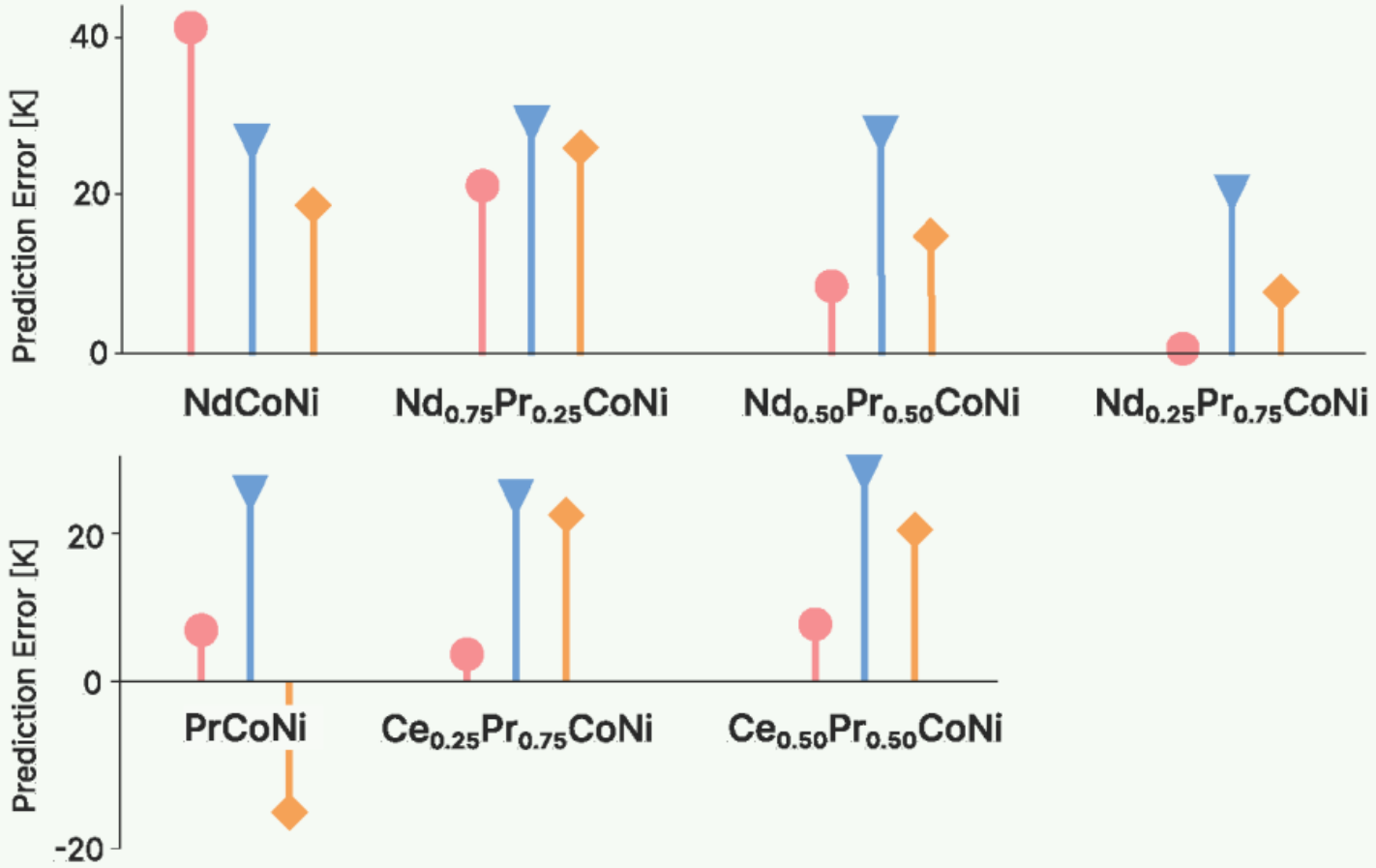
Cubic Laves



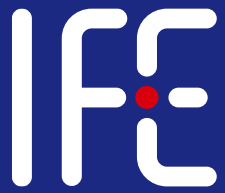
Synthesis and characterization of promising compounds



Cubic Laves



Verification of predicted Curie temperatures and magnetocaloric effect



Thank you for your attention!

Vilde Gahr Sturtzel Lunde

Materials for Magnetocaloric Hydrogen Liquefaction ife.no vilde.lunde@ife.no