NÉEL INSTITUTE Grenoble

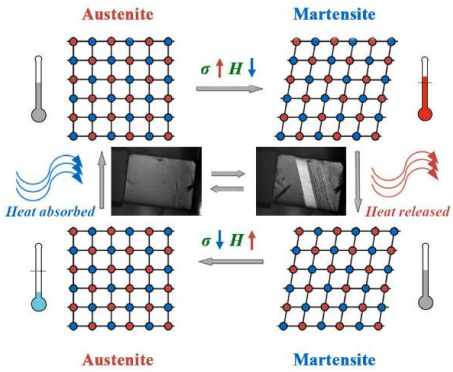
Topic for Master 2 internship – Academic year 2022-2023

Eco-Refrigeration with elastocaloric materials

General Scope:

To decrease energy consumption for ambient cooling is imperative in the context of global warming since it represents 20 % of our CO_2 production... An alternative to classic gaz compresion cycle is the elasto-caloric cycling described below which has attracted significant attention in the literature. Elasto-caloric heat pump technologies emerged as the most promising caloric solution with the highest final score. However to achieve billions of cycles, this process requires fatigue resistant materials. This project targets to develop and study highly recycable materials made of non critical ressource elements,for example FeMn based shape memory alloys.

The heat pump is based on caloric effects where the temperature and entropy changes under the application of an external field to a given material. The elastoc-aloric effect (eCE) is related to the isothermal change of entropy or the adiabatic change of temperature that takes place when an external stress is applied or released to the material. It corresponds microscopically to a solid-solid structural transition (austenite ↔ martensite) triggered by the applied stress (see left figure). Magneto-caloric effect can also exist in some of the elasto-caloric alloys: both external stress and magnetic field can then trigger the phase transition: it brings versatility and the possibility to used them in broad applications. However, the giant caloric effect is inseparable from a thermal hysteresis resulting from the strain incompatibility between the two solid phases and usually responsible for poor mechanical fatigue properties. Several alloy design (optimisation of composition, processing route) can be followed to improve this property: this constitutes the core topic of the training.



Research topic and facilities available:

- improvement of new processing route of metallic micro-wires (Taylor-Ulitovski) and melt-spun ribbons,
- a better understanding of the structural transformation, strain relaxation mechanisms and associated residual structural defects for ferromagnetic Shape Memory alloys,

We offer

-Dynamic environment with rich experimental and original facilities ,

-Multidisciplinary research topic covering physics, materials science and technology,

Possible collaboration and networking:

SIMaP laboratory (Marc Verdier)

Possible extension as a PhD: Yes.

Required skills:

-Strong interest in experimental physics

-Material science

Starting date:March or April 2022 fir internship

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