RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM

Field: Materials Science, Mechanics, Fluids

Subfield: Materials science and mechanics

Title: Experimental and numerical development of a High-Entropy High-Temperature Shape Memory Alloy (HE-HTSMA)

ParisTech School: Arts et Métiers Sciences et Technologies

Advisor(s) Name: Fodil MERAGHNI and Sophie BERVEILLER
Advisor(s) Email: ***fodil.meraghni@ensam.eu ;***
sophie.berveiller@ensam.eu
Research group/Lab: SMART/LEM3
Lab location: Metz (France). www. Lem3.unvi-metz.fr
(Lab/Advisor website):

Short description of possible research topics for a PhD:

One on hand, High Entropy alloys are under development: these single-phased materials contain at least 5 chemical elements which is responsible for high mechanical properties. On the other hand, SMAs exhibit superelastic and/or shape memory effect, induced by a reversible martensitic transformation that can occur at high temperatures (leading to the so-called HTSMA). The aim of this study is to combine both behavior, HE and HTSMA, to develop a HE-HTSMA in order to improve the mechanical properties of a Ti-Nb SMA over a large range of temperature. For that purpose, two main objectives will be achieved:

- Experimental part: first, the specific composition will be chosen based on HE criteria. After elaboration, the microstructure and mechanical behavior will be characterized and optimized by thermal treatments.
- Numerical part: based on these experimental data, a micromechanical model will be developed taking into account the martensitic transformation in the behavior law.

Required background of the student: materials science, diffraction

A list of 5 (max.) representative publications of the group: (Related to the research topic)

1. PELTIER L, LOHMULLER P, MERAGHNI F, BERVEILLER S, PATOOR E, LAHEURTE P. Investigation and Composition Characterization of a “NiTi-like” Alloy Combining High Temperature Shape Memory and High Entropy. Shape Mem Superelasticity 2020. 6(2), pp. 273-283

2. CAUVIN L, RAGHAVAN B, BOUVIER S, WANG X and MERAGHNI F. Multi-Scale Investigation of Highly Anisotropic Zinc Alloys Using Crystal Plasticity and Inverse Analysis. Materials Science and Engineering: A, 2018; 729:106–118.

3 .CHEMISKY Y, HARTL DJ, MERAGHNI F. Three-dimensional Constitutive Model for Structural and Functional Fatigue of Shape Memory Alloy Actuators. International Journal of Fatigue. 2018; 112:263–278.

4. CHATZIATHANASIOU D, CHEMISKY Y, CHATZIGEORGIOU G, MERAGHNI F. Modeling of coupled phase transformation and reorientation in shape memory alloys under non-proportional thermomechanical loading. International Journal of Plasticity, 2016; 82: 192-224.

5. CHATZIATHANASIOU D, CHEMISKY Y, MERAGHNI F, CHATZIGEORGIOU G, PATOOR E. Phase Transformation of Anisotropic Shape Memory Alloys: Theory and Validation in Superelasticity, Shape Mem. Superelasticity, 2015; Vol. 1; pp. 359-374.
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