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AU SERVICE DE LA SCIENCE

INSTINCT – In situ micromechanical investigation of solids under extreme conditions

Réunion de lancement ANR 2022

Szilvia Kalacska, CR CNRS
08 Dec. 2022

Project identity sheet

- Acronym: **INSTINCT**
- Title: **In situ micromechanical investigation of solids under extreme conditions**
- Partners:

  1/ Laboratoire Georges Friedel (LGF): *S. Kalacska, G. Kermouche, F. Christien*

  2/ Laboratoire des Sciences des Procédés et des Matériaux (LSPM): *Yann Charles*

  3/ Science et Ingénierie des Matériaux et Procédés (SIMAP): *Marc Fivel*

  4/ Eötvös Loránd University (ELTE, Hungary): *P.D. Ispánovity*
- Project start date: **02 January 2023.**
- Duration : **42 moths**
- ANR help: **271 k€**
- Full cost: **585 k€**
- Instrument specificity: **JCJC - Jeunes chercheurs - jeunes chercheuses**

INSTINCT
ANR-22-CE08-0012-01

MINES Saint-Étienne
Une école de l'IMT

LGF UMR 5307
MATÉRIAUX, MÉCANIQUE, PROCÉDÉS

cnrs

LSPM

SIMaP

anr

Context

•MICROMECHANICS: **Materials' response** to external deformation fundamentally **differs from bulk as the sample size is reduced**

•Understanding mechanisms of deformation at the sub-micron scale is the **key for designing new materials** and alloys for industrial applications

•EXTREME CONDITIONS: hydrogen causes **degradation of mechanical performance** in metals, the microscale mechanisms remain a subject of debate

•IN SITU: direct H-detection within the lattice is an **extremely challenging** task, while one has to deal with **continuous diffusion and outgassing issues** from small samples

Zero-emission commercial / scientific aircraft

Extreme conditions (vibrations, shock, refueling)

The method will be **applicable for the industrial development**

B.3: Metallic and inorganic materials

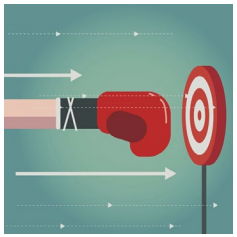
understanding the (mechanical) properties of materials (functional properties, metallurgical thermodynamics, microstructures, damage, fatigue, corrosion)

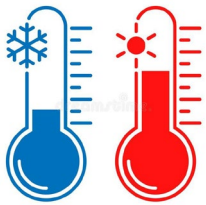
Scientific and technical objectives

Paving the way towards **mechanical characterization of materials subjected to extreme environmental conditions at small scales**.

These extremities include **high strain rates** (10^3 s^{-1}) and **temperatures** varying between **cryogenic** (down to -150°C) up to **medium ranges** (room temperature to ~400°C).

In particular, project INSTINCT aims to study materials' characteristics in the **hydrogen context**.





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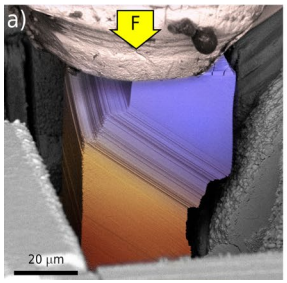
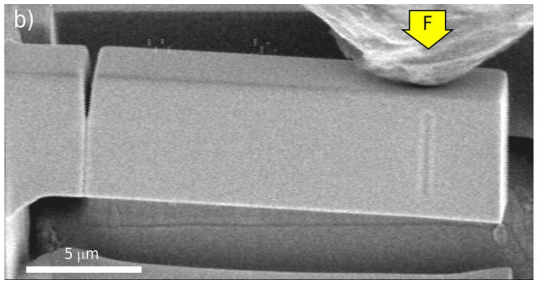
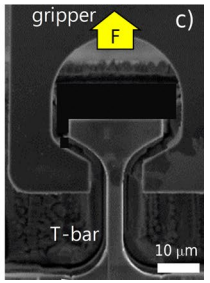
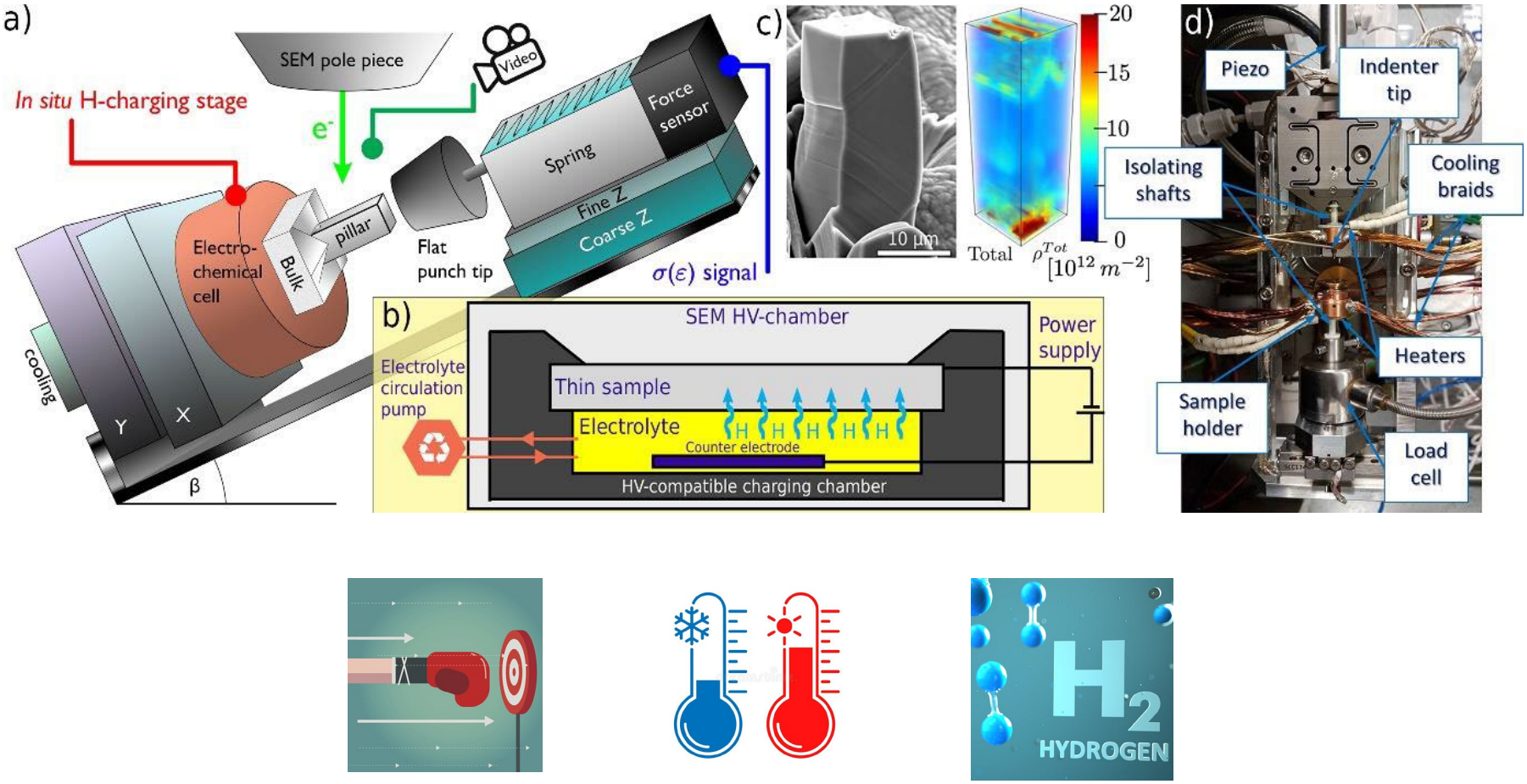






Scientific and technical objectives



Expected benefits

Scientific impact:

- ✓ strengthen collaborations
- ✓ develop and apply *in situ* experimental techniques
- ✓ perform cutting-edge measurements

Economic and social impact:

- ✓ The global economy is in desperate need of safe infrastructure and transport solutions of sustainably energy
- ✓ Carrying out tests by measuring mechanical properties at the right scale in the right circumstances
- ✓ Contribute to the European and French target to become carbon neutral by 2050

Expected contribution to the **design of new functional and structural materials** and better understanding of hydrogen embrittlement processes.

https://www.micromechanics.fr/