

Exploring the relationship between microstructure, storage properties, and hydride ageing in solid-state hydrogen materials

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Context

CYCLAHMID project (CYCLing of Hydride Alloys: Microstructure and Decrepitation) financed by the Graduate School EUR EIPHI and with the support of the Bourgogne Franche-Comté region.

Problem :

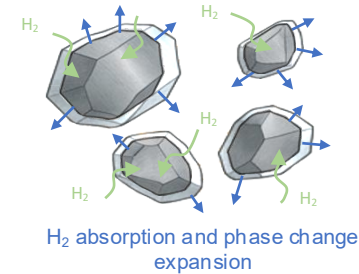
- **Aging of intermetallic** alloys under cycling → particle size refinement, powder bed densification, leading to **tank damage**
- **Insufficient understanding of multi-scale mechanisms** hindering the industrialization of solid-state hydrogen storage

Objectives and methods

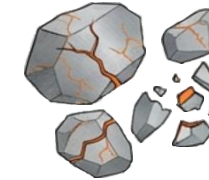
Identify the physico-chemical and mechanical mechanisms responsible for aging under cycling of **three intermetallics and one high-entropy alloy**

Scientific tools :

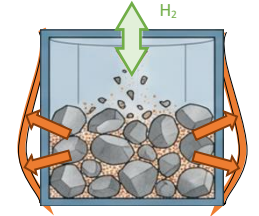
- Scanning Electron Microscopy (SEM),
- Energy Dispersive Spectroscopy (EDS),
- Electron Backscatter Diffraction (EBSD)
- Ultra-nanoindentation on micro grid and clustering
- X-ray diffraction (XRD)
- Sieverts-type volumetric H-uptake measurements (PCT, hydriding kinetics)
- In-situ observations of hydriding



H₂ absorption and phase change expansion



Progressive particle self-fragmentation with each cycle



Powder swells, shrinks, settles, segregates over successive cycles

Tank wall damage

