*S*eeing *H*ydrogen ***in*** *Matt**e**r*

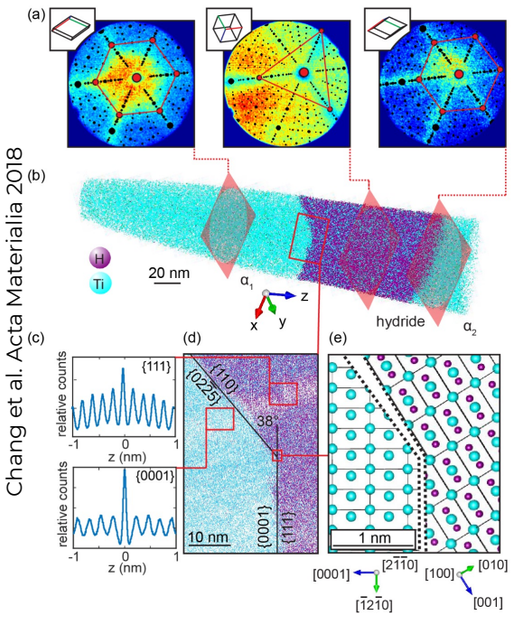
ERC-Consolidator: SHINE

Dr. Baptiste Gault, MPIE

MAX-PLANCK-INSTITUT
FÜR EISENFORSCHUNG GmbH

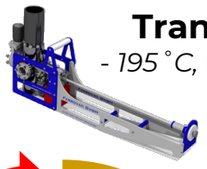
ERC-funded group:. L.T. Stephenson, P. Chakraborty, A. El-Zoka, S.-H. Kim, H. Khanchandani, B. Gault
+ collaborations with T. Hickel, Y. Chang, B. Sun, H. Zhao, D. Ponge, D. Raabe

European Research Council
Established by the European Commission



Chang et al. Acta Materialia 2018

Atomic-scale analysis of titanium and a hydride causing its embrittlement



Transfer Module
- 195 ˚C, ultrahigh-vacuum

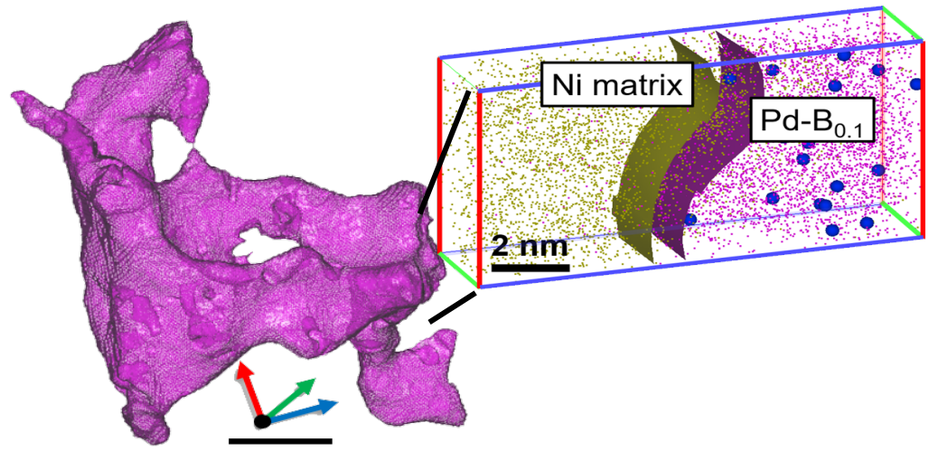
Atom Probe Tomography
Microanalysis at the atomic scale:
We can 'count H atoms one by one'

Scanning Electron & Ion Microscope
Sub-micrometer imaging and specimen preparation at -160 ˚C

SHINE's approach

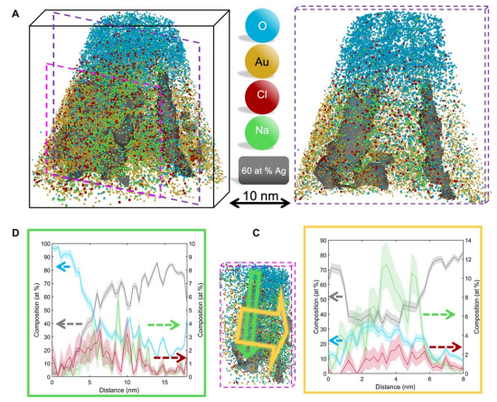
- **atom-scale characterisation** to unlock understanding of **H behaviour on world-unique microscopy infrastructure**
- combined with **atomic-scale simulations**

Doping Pd nanomaterials for water splitting

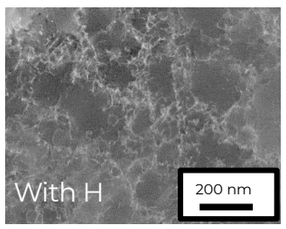


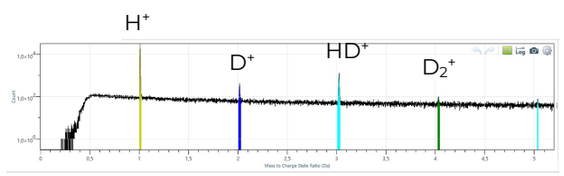
Active surface in contact with water

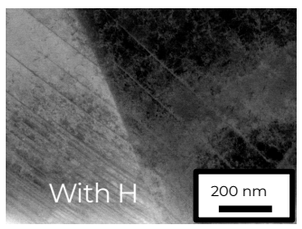
Energy generation, storage, decarbonation of industry & transport
Analysis and design of materials for the hydrogen economy, improve performance for hydrogen production, solid-state hydrides, fuel cells, catalysts etc.

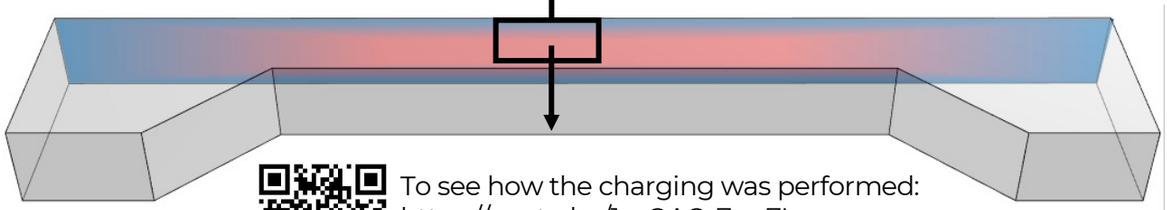


El-Zoka et al.; Science Advances 2020

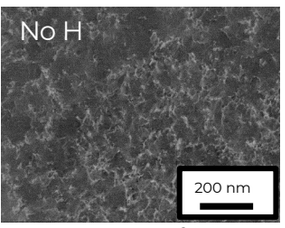


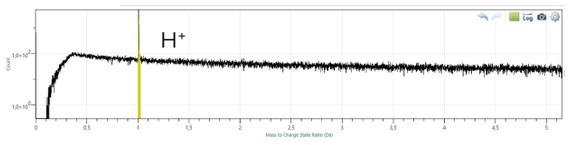


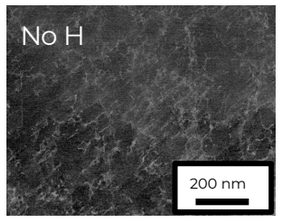




To see how the charging was performed:
https://youtu.be/1mQAC_7_w7I

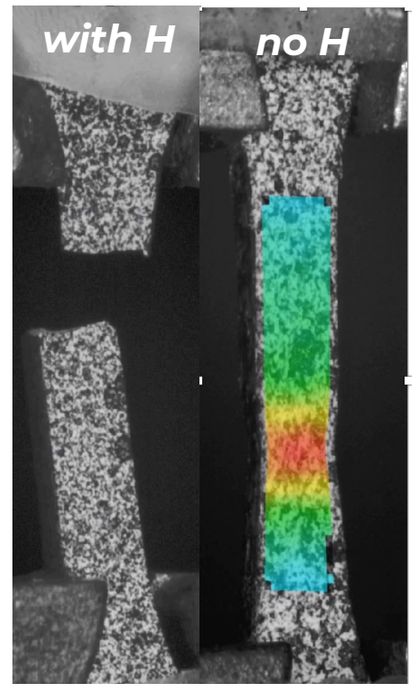






Differences of deformed structure and detection of H to understand the mechanisms

Hydrogen accelerates the degradation of metals & alloys
Analysis of steel and aluminium alloys subject to strong embrittlement and improvement in their design to enhance longevity in service to improve sustainability and facilitate the hydrogen economy



Dramatic loss of ductility caused by H in high-strength steel