Collaboration across borders

Magnus Fredriksson *Ph.D.*

Alfa Laval
key figures

Founded in

1883

140 years of experience in
engineering and innovation

Employees

22,000+

37 major production units globally
Presence in over 100 countries

Order intake 2023 (MSEK)

70 742

EBITA: 16.1 %
ROCE: 21.0 %

Patents

4,200+

Annual investment in research and
innovation: 2.5 % of total net sales

Key **technologies**

Applicable in +20 different product groups

Heat transfer

Separation

Fluid handling

Alfa Laval

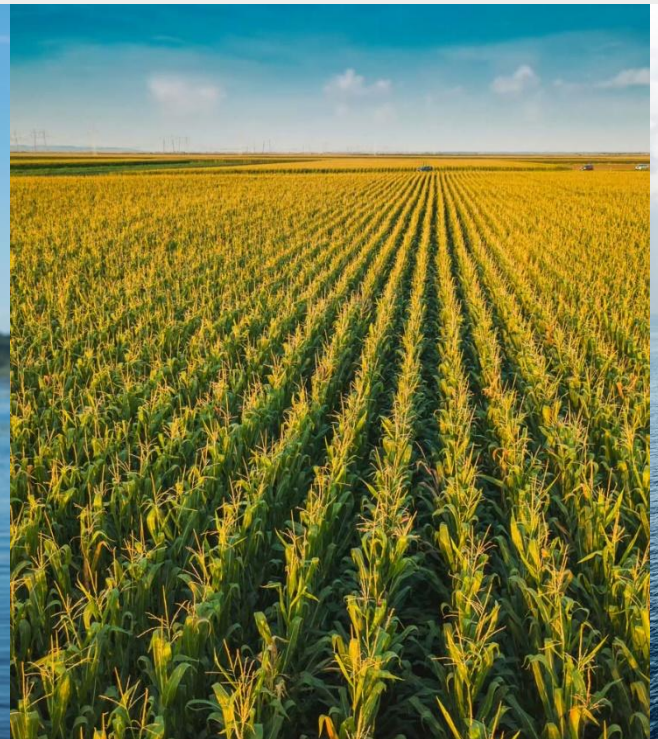
The world is facing some **big challenges**

These include rising demand for:

Energy transition

Clean water

Sustainable food

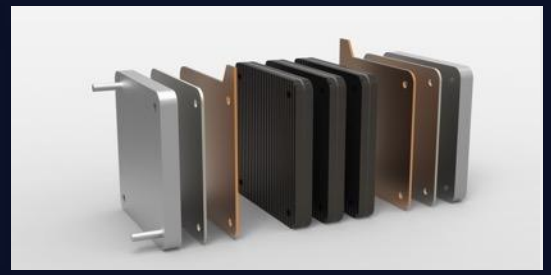


Marine transportation

Emerging energy technologies

Proximity to material research is crucial for success

Green hydrogen



Fuel cells

Energy storage

Power-to-X

Carbon capture utilization and storage (CCU/S)

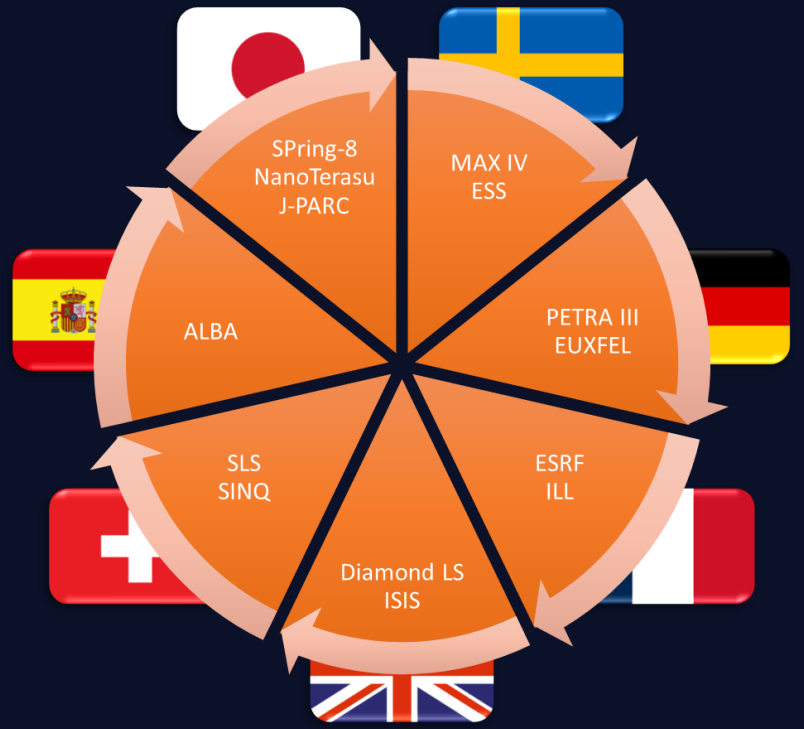
Biofuels

Concentrated Solar Power (CSP)

Wind power

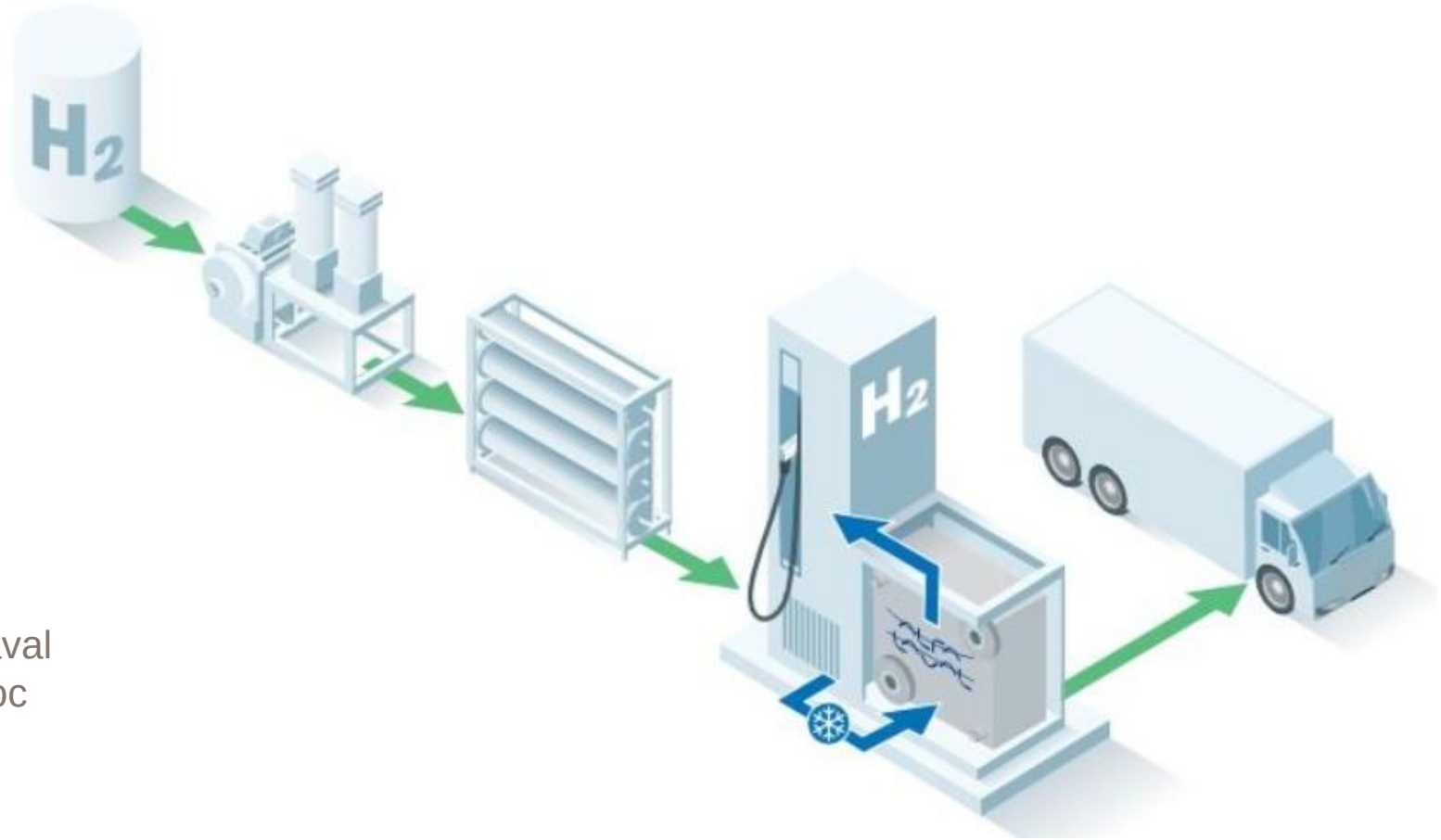
Large scale research infrastructures

Toolbox of excellence in our network

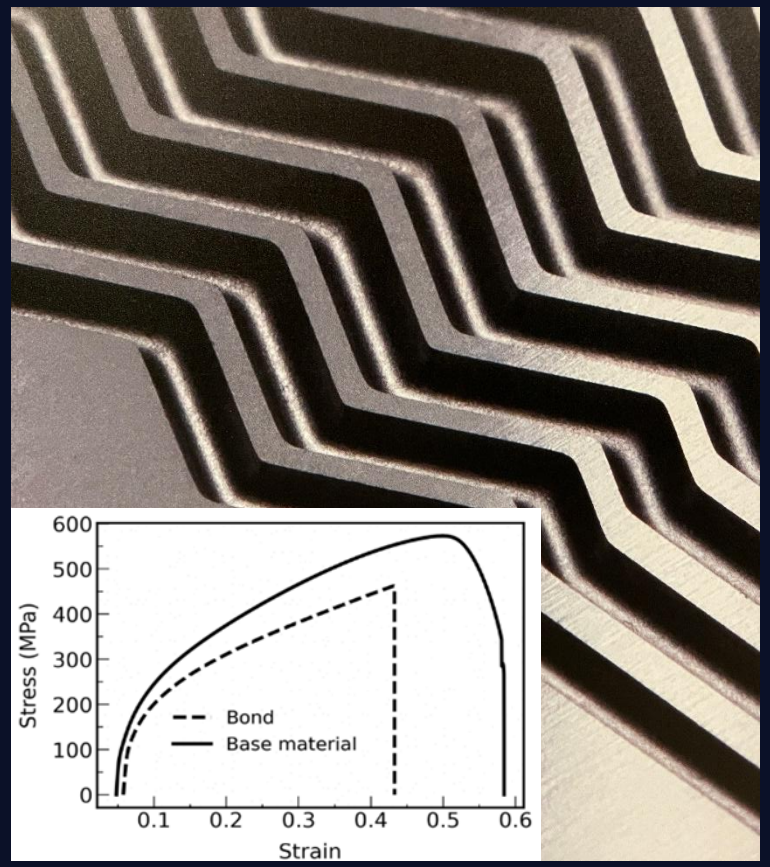


Hydrogen refuelling pre-cooling system

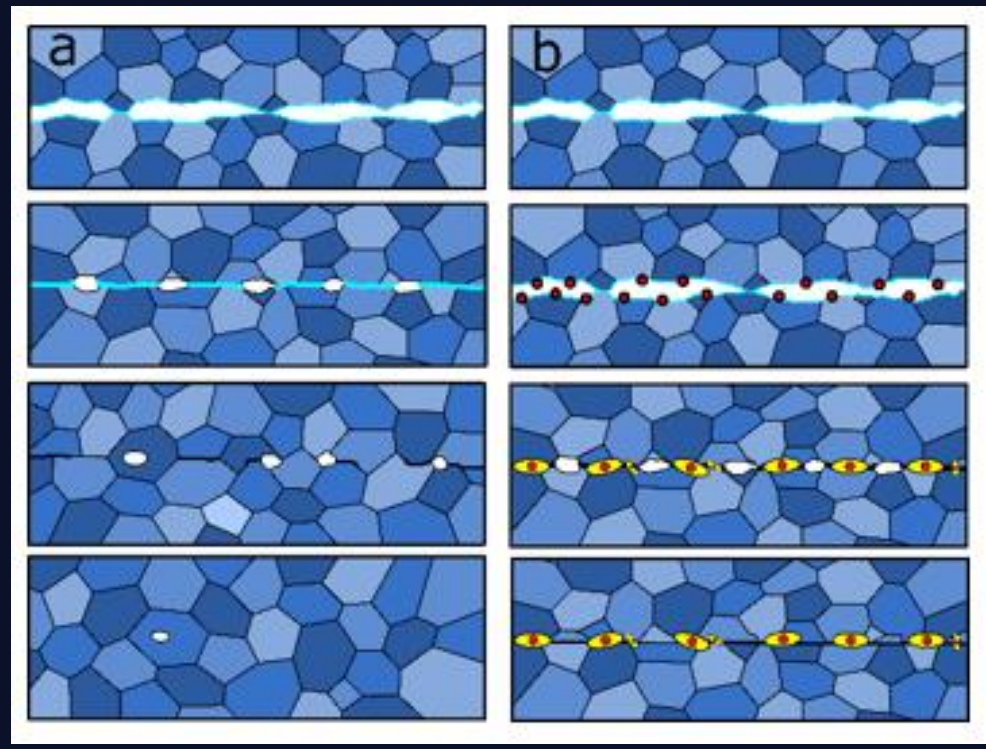
Alfa Laval
HyBloc



Diffusion bonded heat exchangers



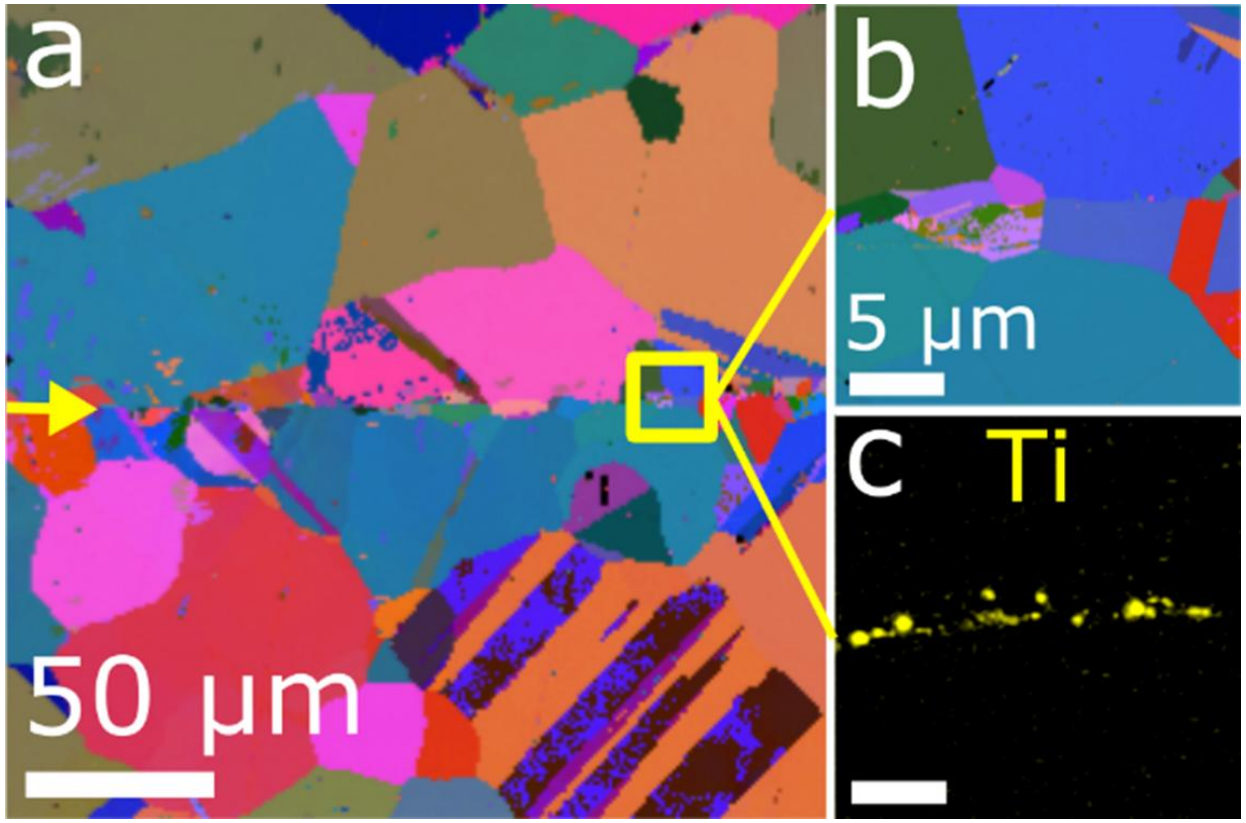
Heat transfer plate

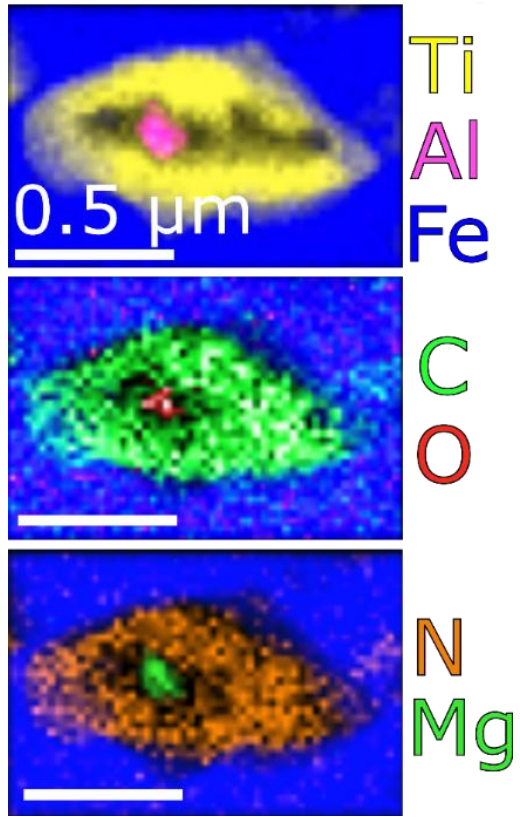


Precipitations at the bond interface prevent adequate grain migration.

Investigation of diffusion bonds

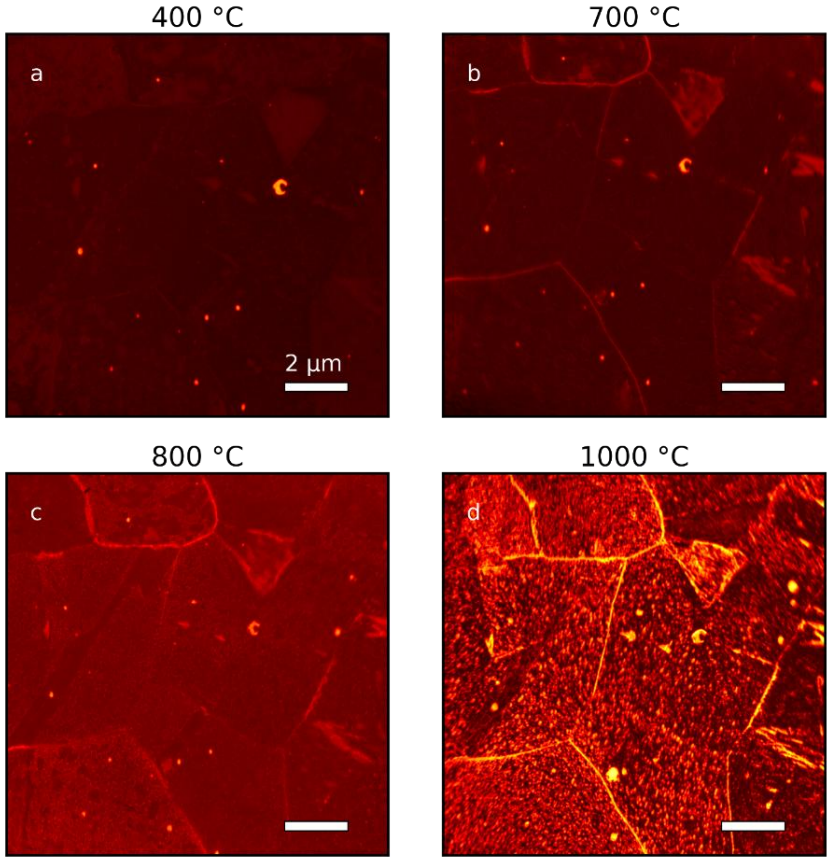
EBSD and EDS of the joint cross-section

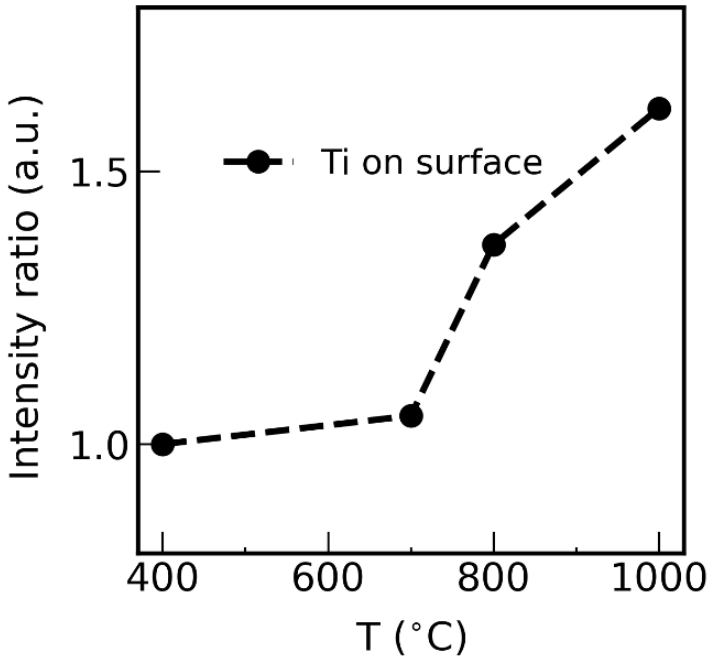




In situ characterization using MAXPEEM

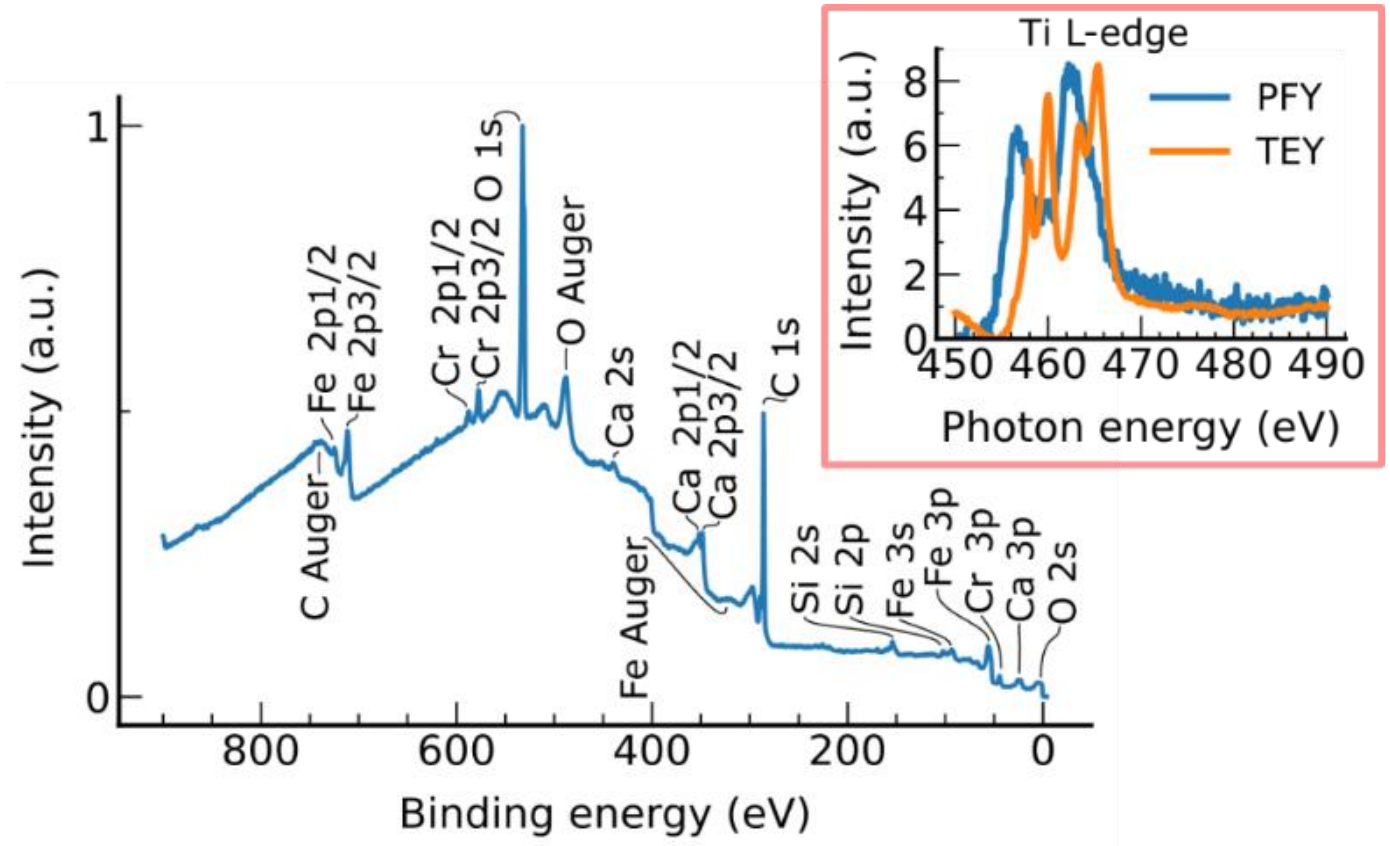
XAS-PEEM images show increase in Ti concentration and agglomeration as temperature rises



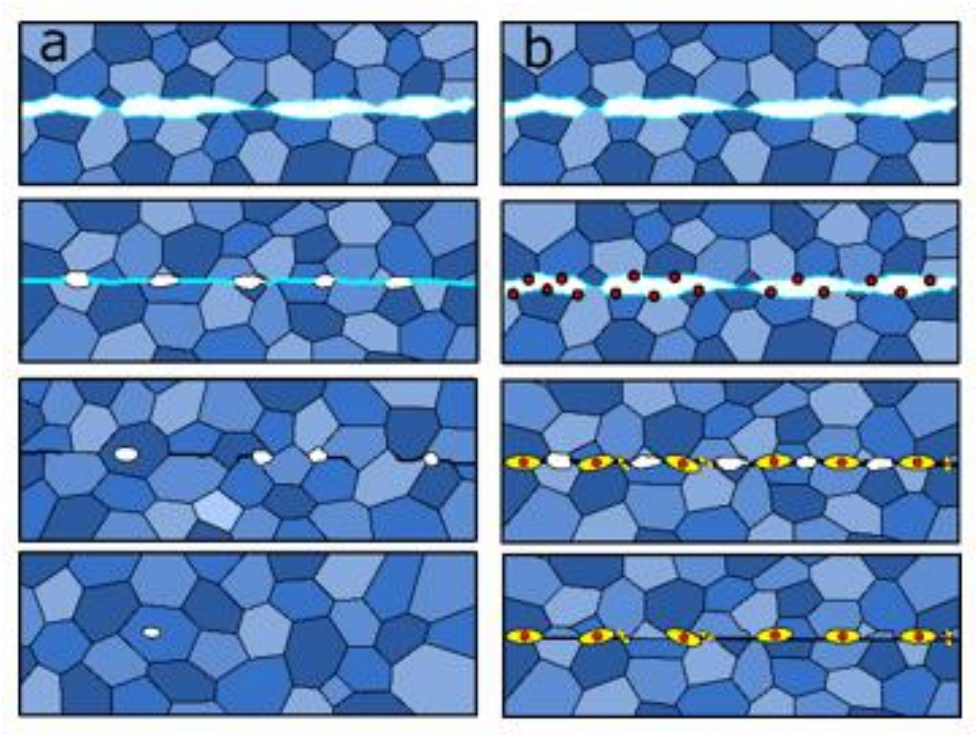


Using FlexPES for surface analysis

X-ray photoemission spectrum of 321H steel at room temperature



Outcome



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Microscopy AND Microanalysis

Diffusion Bonding 321-Grade Stainless Steel: Failure and Multimodal Characterization

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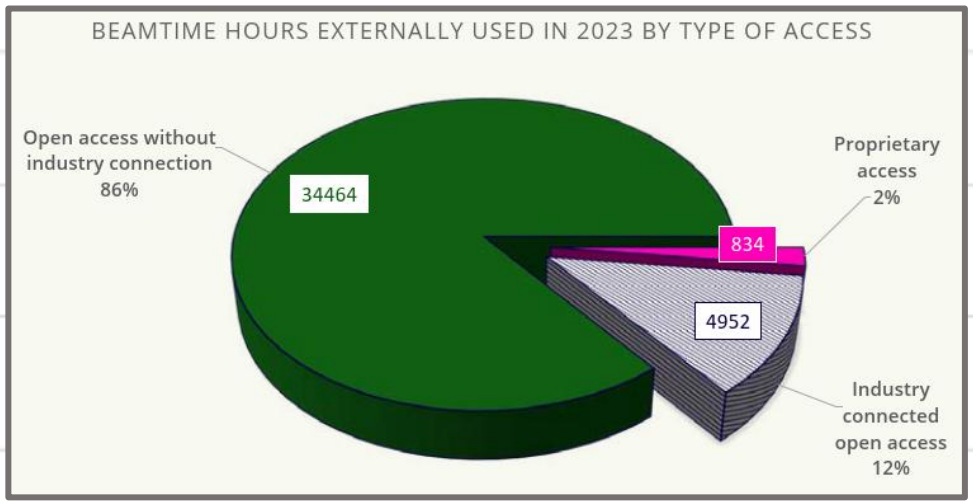
Abstract

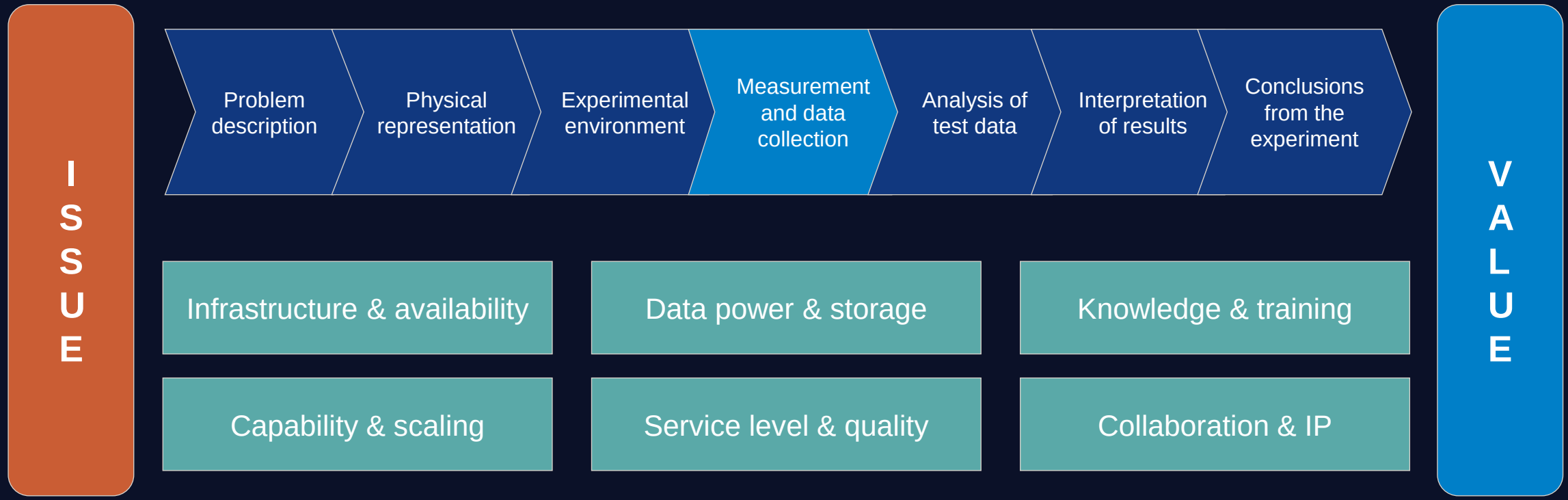
Vacuum diffusion-bonded printed circuit heat exchangers are an attractive choice for the high-temperature, high-pressure demands of next-generation energy applications. However, early reports show that the high-temperature materials desired for these applications suffer from poor bond strengths due to precipitation at the bond line, preventing grain boundary migration. In this study, a diffusion bond of the high-temperature stainless steel grade 321H is investigated, and poor mechanical properties are found to be caused by Ti(C, N) precipitation at the bond line. Through *in situ* studies, it is found that Ti diffuses from the bulk to the mating surfaces at high temperatures. The Ti subsequently precipitates and, for the first time, an interaction between Ti(C, N) and Al/Mg-oxide precipitates at the bond line is observed, where Ti(C, N) nucleates on the oxides forming a core-shell structure. The results indicate that small amounts of particular alloying elements can greatly impact diffusion bond quality, prompting further research into the microstructural evolution that occurs during bonding conditions.

Key words: core-shell, diffusion bonding, microstructure, PEEM, stainless steel, TEM, Ti-rich precipitation

INDUSTRY-CONNECTED BEAMTIME HOURS IN 2023 BY TYPE OF ACCESS AND INDUSTRY SECTOR



Value chain and functions for industry



Identified barriers for industry

Cost

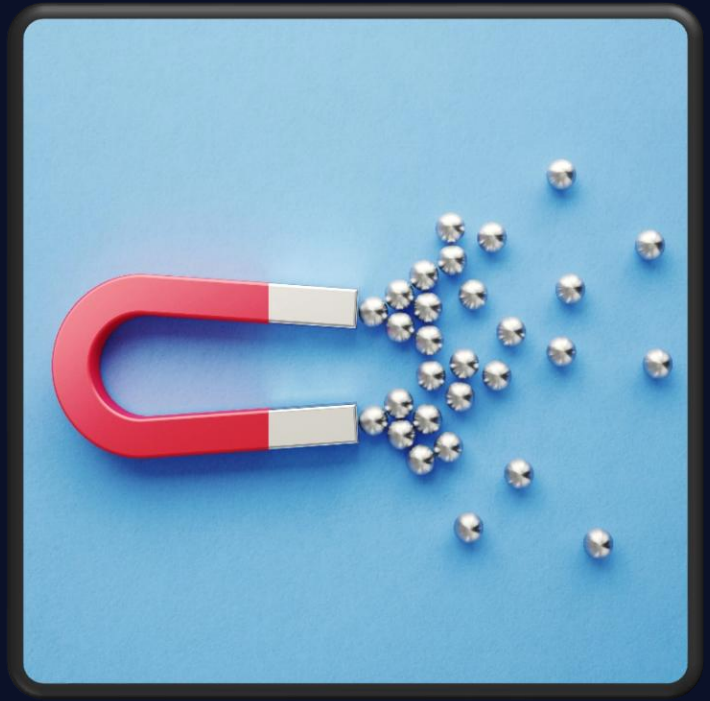
Access

Packaging

Mandate

Dependencies

The way forward to establish the industry platform



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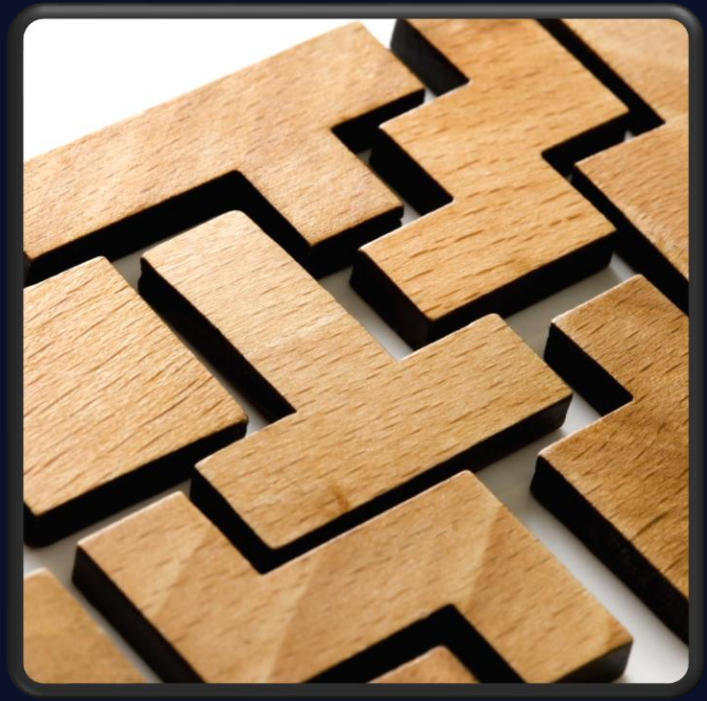

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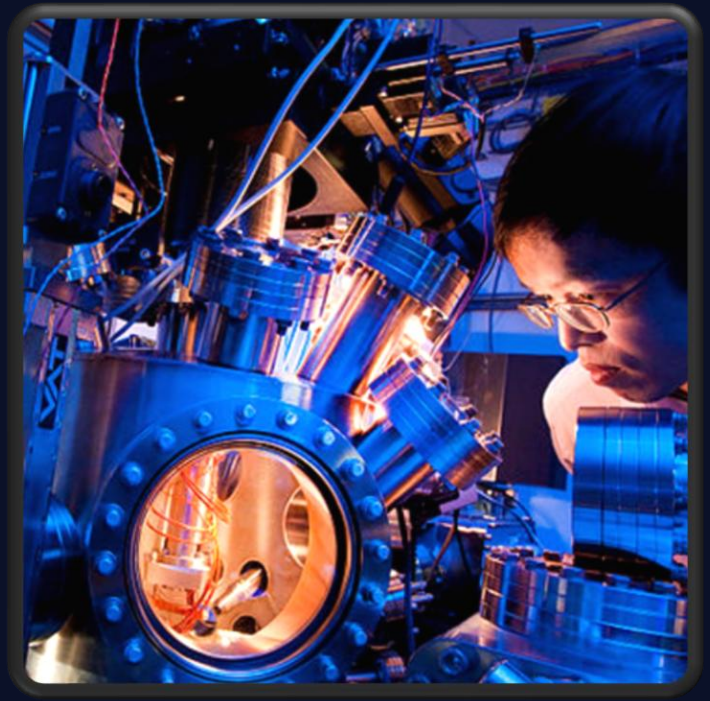

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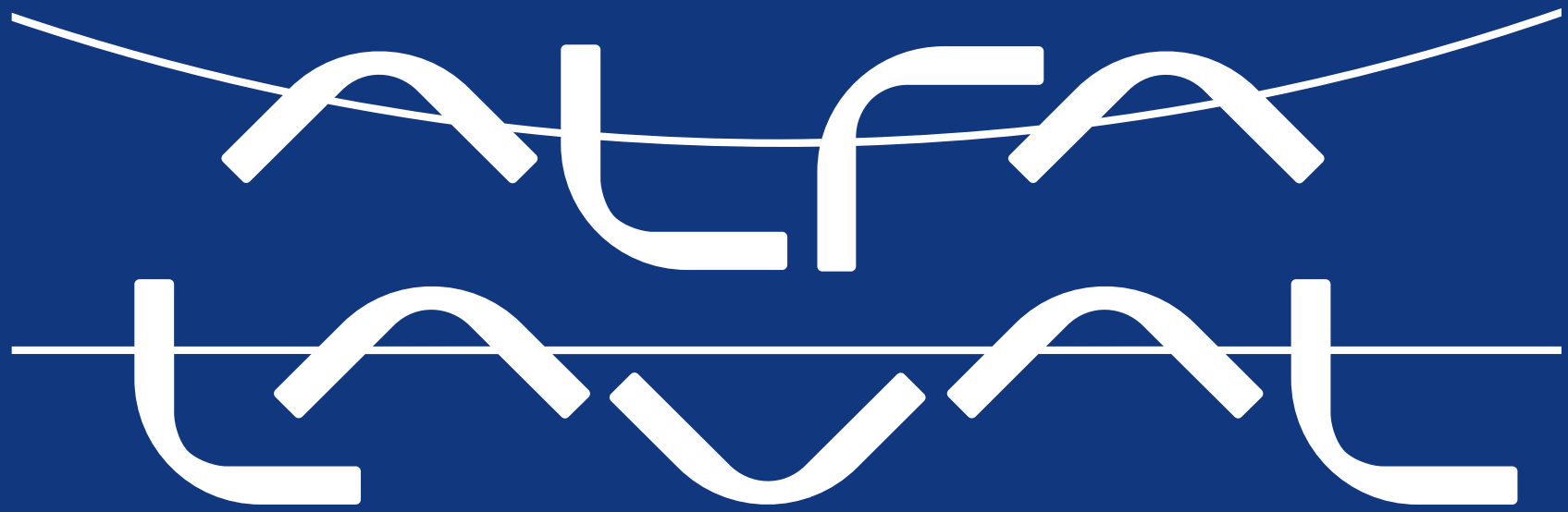
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