Workshop: Hydrogen and metallic materials

The production, transport, storage and use of hydrogen as an energy source in a variety of applications is becoming a key technology to assist with the transition to a low carbon energy economy. Hydrogen produced by water electrolysis using electricity from renewable resources such as wind and solar can be transferred and used in fuel cells for many forms of transport and in industrial applications such as CO₂-free steel production, heating, and electricity generation, especially if stored for periods of low wind and solar energy production.

The transport, storage and use of hydrogen involves the interaction of gaseous hydrogen with many metallic materials used for construction of membranes in electrolyzers, hydrogen treatment units, pipelines and storage vessels. Atomic hydrogen can form by dissociation of gaseous hydrogen molecules that adsorb on metal surfaces or by reduction of hydrogen ions present in water electrolytes in immersion or atmospheric conditions. It can enter the metal lattice causing potential embrittlement and hydrogen-assisted cracking mechanisms. Effects of gaseous hydrogen on the tensile, fracture and fatigue properties of steels have also been observed. Although the effects of hydrogen on metallic materials have been studied for many decades, the development of a global hydrogen economy and the associated increase in applications involving interaction of hydrogen with metallic materials, has resulted in a steep rise in research as we try to create a better understanding of the many aspects of these interactions that are still unclear. In this respect there is much experience to be shared between experts on the energy transition, automotive high strength steels, aluminium alloys for aerospace applications, and the oil & gas sector.

The aim of this joint session chaired by Christine Blanc from WP 5 Environment Sensitive Fracture is to bring together academia and industry to create a platform for exchange of knowledge and ideas with the goal of identifying issues associated with the interaction of hydrogen with metallic materials in relation to specific fields of application, and then identifying potential solutions.

The key themes for the joint session will be:

- Impact of hydrogen on materials used for transport and storage.
- Issues related to the use of hydrogen in fuel cells and industrial applications.

The joint session will focus on the following topics:

- Mechanisms of atomic hydrogen formation and entry into metal lattices including transport, trapping and de-trapping.
- Interaction of hydrogen at the atomic scale involving crack formation and propagation.
- Identification of issues associated with hydrogen in each application field (carbon and high strength steels, stainless steels, aluminium, etc.) and analysis of the specific conditions of use (physico-chemical properties of the environment, constant and cyclic mechanical loading).
- Possible solutions identified in each field of application for mitigation of the effect of hydrogen interactions including microstructure modification, material selection, alloying, surface treatment, coatings.
- Techniques and experience with measurement of hydrogen formation, entry and mechanical effects.
- Effect of hydrogen on existing transport and storage infrastructures including assessment methods.
- Impact of hydrogen interactions in electrolyzers and fuel cells and technical solutions to meet electrolyser and fuel cell materials corrosion requirements.
- Industry needs for further understanding and development of testing and materials.


We are looking forward to your contribution and participation in EUROCORR 2023 “Closing the gap between industry and academia in corrosion science and prediction”, August 27–31, 2023, in Brussels, Belgium.

Chair: Christine Blanc, WP 5 Environment Sensitive Fracture

Co-chairs: Elizabeth Szala, WP 17 Corrosion in Automotive; Mikhail Zheludkevich, WP 22 Corrosion Control in Aerospace; Tomáš Prošek, WP 25 Atmospheric Corrosion; Steve Paterson, TF Corrosion in Green & Low Carbon Energy Technologies; Gareth Hinds, President World Corrosion Organization

Expected duration: 1 to 2 days
Expected audience: 100–200 attendees