20th European Mechanics of Materials Conference - EMMC20
Florence, Italy | May 27th-29th, 2026
www.emmc20.unifi.it

Mechanistic Insights into Hydrogen-Assisted Intergranular Fracture in FCC Alloys

Abdelali Oudriss[1], Jamaa Bouhattate[2], Xavier Feaugas[3]

[1] Mines Paris – PSL Centre des Matériaux - CNRS UMR 7633, France. abdelali.oudriss@minesparis.psl.eu
[2] University of La Rochelle LaSIE UMR CNRS 7356, France. jamaa.bouhattate@univ-lr.fr
[3] University of La Rochelle LaSIE UMR CNRS 7356, France. xfeaugas@univ-lr.fr

Paper ID: 671
Symposium S8: Fracture, and damage of materials

Abstract

The interaction of hydrogen with metallurgical heterogeneities plays a central role in hydrogen-assisted plasticity and fracture mechanisms in face-centered cubic (f.c.c.) alloys. In nickel-based alloys, grain boundary character and precipitate state emerge as key microstructural parameters that can be tailored to improve resistance to hydrogen embrittlement. A detailed understanding of hydrogen–microstructure interactions is therefore required to clarify their contribution to intergranular fracture. This work first highlights the antagonistic effects induced by hydrogen, which may lead to either local hardening or softening depending on the nature of the interactions, thereby complicating the interpretation of hydrogen-assisted damage mechanisms. Multi-scale analyses are then used to emphasize the critical role of hydrogen mobility, including short-circuit diffusion paths and dislocation-mediated transport, in governing plasticity and fracture processes. Particular attention is paid to hydrogen interactions with grain boundaries, precipitates, dislocations, and voids, and their combined influence on intergranular fracture behavior in f.c.c. alloys.

Keywords:

Hydrogen embrittlement Intergranular fracture Plasticity Hydrogen transport and trapping