MULTI SCALE STUDY OF THE EFFECT OF HYDROGEN AND GRAIN BOUNDARY CHARACTER ON PLASTICITY MECHANISMS IN PURE NICKEL

Yasmine Ben Jedidia, La Rochelle University, LaSIE UMR CNRS 7356
yasmine.ben_jedidia@univ-lr.fr
Abdelali Oudriss, La Rochelle University, LaSIE UMR CNRS 7356
Siva Prasad Murugan, La Rochelle University, LaSIE UMR CNRS 7356
Xavier Feaugas, La Rochelle University, LaSIE UMR CNRS 7356

The effect of hydrogen on the interaction between plasticity and grain boundary character was investigated in pure nickel using tensile tests and nanoindentation. Tensile tests were performed on polycrystal hydrogen-charged-nickel having different grain sizes in order to question the effect of hydrogen and grain boundary distribution on the plasticity mechanisms. In the presence of hydrogen, yield strength and ductility are impacted differently as a function of grain size and grain boundary character. On the other hand, we observed an antagonist hardening/softening effect of hydrogen. These effects could be questioned in relation with the role of grain boundary character and its distribution, on the hydrogen diffusion and trapping in nickel [1]. In addition, the fractographic observations revealed an intergranular fracture mode in the hydrogen pre-charged specimens, associated with the presence of slip bands and localized nanovoids near some grain boundaries. These analyses suggest that intergranular fracture induced by hydrogen could result from the accumulation of vacancy clusters and/or specific plasticity mechanism along grain boundaries. In order to understand the interaction between hydrogen and grain boundary, and to dissociate from the influence of grain orientation, the nanoindentation tests were carried out on single-crystals, bi-crystals, and polycrystals pure nickel. The hydrogen effect on the resolved modulus, pop-in load, and hardness, at different grain orientations and near grain boundaries obtained from nanoindentation tests, will be discussed.

[1]: A. Oudriss, J. Bouhattate, C. Savall, J. Creus, X. Feaugas F.A. Martin, P. Laghoutaris, J. Chêne, On the implication of hydrogen on inter-granular fracture, Procedia Materials Science 3 (2014) 2030 – 2034.