Understanding hydrogen behaviour in steels

Daniel GAUDE-FUGAROLAS[1]

[1] *dgaude Prime Innovation SLU*
Independent Research in Physical Metallurgy and Engineering
c/. Alcalde Joan Batalla, 4,
08340 Vilassar de Mar (Spain)

dgaude@cantab.net

RÉSUMÉ.

Small amounts of hydrogen can sometimes cause embrittlement of high strength alloys. Because of their technological and economic relevance, intense research is underway worldwide to improve our understanding of such phenomena.

A physical model has been used to study hydrogen behaviour during manufacturing of metallic alloys. In particular, the present model contemplates diffusion in its most comprehensive description, i.e., atom diffusion being driven by the gradient in chemical activation, instead of simply occurring down a composition gradient. The model incorporates as well the influence of thermal history, microstructure, matrix solubility, multiple trapping distributions, and interaction with the atmosphere.

Using this model is possible to describe and predict the behaviour of hydrogen in metals during real industrial processes. For instance, it explains the effect on hydrogen redistribution of parameters like treatment conditions, component size and microstructure, phase transformation temperature, grain size, carbide distribution, deformation level, etc.

Furthermore, a set of criteria have been developed to anticipate defect formation and embrittlement risk, based on hydrogen supersaturation.

Last but not least, a method has been developed during this work, which enables to reduce hydrogen content from the metal via the use of imposed temperature gradients. This method has recently obtained several patents.

MOTS-CLÉS : Steel, Hydrogen, Embrittlement, Model.