Invitation à la soutenance publique de thèse de
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Master ingénieur civil en chimie et science des matériaux

Pour l’obtention du grade de Docteur en sciences de l’ingénieur et technologie

« On the interactions between atmospheric hydrogen sources and 22MnB5 steel »

qui se déroulera
le lundi 11 février 2019 à 16h15
Auditoire SUD 01
Place Croix du Sud
1348 Louvain-la-Neuve

Membres du jury :
Prof. Pascal Jacques (UCLouvain), supervisor
Prof. Renaud Ronsse (UCLouvain), chairperson
Prof. Thomas Pardoen (UCLouvain), secretary
Dr. Cédric Georges (CRM group, Belgium)
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Dr. Frantz Martin (CEA Saclay, France)

The hot stamping process of Al-Si coated boron steels is an interesting shaping solution to provide simultaneously high strength and ductility, which is compulsory for the current challenges of the automotive industry. Exposed to various atmospheres during high temperature operations, steels absorb small amounts of hydrogen, which can lead to hydrogen embrittlement (HE). As hydrogen sensitivity increases roughly with strength, the risk of HE becomes a major issue in the development of advanced high strength steels. In this context, the aim of the present thesis is to understand the interactions between atmospheric sources of hydrogen and the particular 22MnB5 hot-stamped steel. For this purpose, the bare or coated material was exposed to controlled atmospheres containing hydrogen sources during austenitization heat treatments. Two main sources of hydrogen were used: H₂, which allows a fundamental study already well documented in the literature; and H₂O, which is likely the active source in the industrial practice. A specificity of the present work also consists of the use of deuterium, a hydrogen isotope.

A major part of this thesis deals with a critical assessment of the methodology related to the use of deuterium instead of, or combined with hydrogen in bare 22MnB5 steel. Indeed, despite their isotope nature, hydrogen and deuterium exhibit slight differences called isotope effects. Furthermore, when they are exposed to each other, exchanges can occur between them to form hybrid molecules such as HD. Besides these methodological considerations, the specific effect of hydrogen sources is also investigated. Particularly, their related surface oxidation and decarburization effects are scrutinized, while their influence on hydrogen uptake is analysed. Finally, an insight into the hydrogen uptake of Al-Si coated steel is given.