

Influence of microstructure and mechanical stress on the corrosion resistance of metallic alloys : Application of multi-scale and multi-disciplinary methods

Vincent Vignal¹ and Halina Krawiec²

1 ICB, UMR 6303 CNRS – Université de Bourgogne Franche comté,
9 Avenue Alain Savary, BP 47870, 21078 Dijon Cedex, France

2 Faculty of Foundry Engineering, AGH University of Science and Technology,
ul. Reymonta 23, 30-059 Krakow, Poland

Abstract

Metallic alloys have complex microstructure possibly composed of several metallic phases, secondary phases, particles and inclusions. These different metallurgical constituents of alloys have their own electrochemical behaviour and mechanical properties. Heterogeneous stress fields may then be generated at the specimen surface and in the sub-layer. They may be induced by surface preparation, during elaboration and/or processing. They may also be generated by external loads on field.

Heterogeneous stress fields have significant influence on the electrochemical response of metallic alloys and therefore on their corrosion resistance. Multidisciplinary approaches have been developed at the local scale to study the influence of mechanical stress/strain on the corrosion behaviour of alloys.

These approaches may use numerical simulation and/or experimental methods (both in mechanics and electrochemistry). Applications of these approaches to some engineering alloys (such as duplex stainless steels, martensitic stainless steels, aluminium alloys) will be described. The influence of microstructure and mechanical stress/strain on pit initiation and propagation will be discussed.