

Research Topic for the ParisTech/CSC PhD Program

Field (cf. List of fields below): Chemistry, Physical Chemistry and Chemical Engineering

Subfield: Corrosion, Surface Chemistry

Title: Corrosion protection at the nanoscale

ParisTech School: Chimie ParisTech

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Short description of possible research topics for a PhD:

The IRCP/PCS group at Chimie ParisTech investigates how functional metals and alloys corrode in aggressive aqueous and/or high temperature oxygen-containing environments, how to improve their resistance, and how to design innovative protection strategies.

A PhD topic would be to investigate, at the nanometer scale, the role in the corrosion initiation of the chemical and structural heterogeneities created in ultrathin (< 2 nm) passive oxide films by the oxidation/passivation mechanisms. You would study high purity Cr-containing stainless alloy surfaces in a well-defined corrosive aqueous environment, and adopt a novel methodology combining surface preparation of single crystal substrate surfaces, controlled formation of model oxidized interfaces and surface characterisation under UHV environment before and after electrochemical modification in the corrosive liquid environment.

Another PhD topic would be to characterise and understand the local corrosion properties at the emergence of grain boundaries at a metal surface. You would study a high purity metal in a model corrosive aqueous environment and adopt a novel methodology combining Electrochemical STM and EBSD. The research work would include the surface preparation of the model microcrystalline samples and the *in situ* characterisation of the global electrochemical properties and local corrosion properties, including the role of corrosion inhibitors.

Required background of the student: Materials Science, Electrochemistry; some knowledge of Corrosion and Surface Science would be beneficial.

A list of 5(max.) representative publications of the group:

- V. Maurice, P. Marcus, Progress in Corrosion Science at Atomic and Nanometric Scales *Passive films at the nanoscale*, Progress in Materials Science 95 (2018) 132-171.
- V. Maurice, P. Marcus, Current developments of nanoscale insight into corrosion protection by passive oxide films, Current Opinion in Solid State & Materials Science 22 (2018) 156-167.
- Li Ma, F. Wiame, V. Maurice, New insight on early oxidation stages of austenitic stainless steel from in situ XPS analysis on single-crystalline Fe-18Cr-13Ni, Corrosion Science 140 (2018) 205-216.
- M. Bettayeb, V. Maurice, L. H. Klein, L. Lapeire, K. Verbeken, P. Marcus, Nanoscale Intergranular Corrosion and Relation With Grain Boundary Character as Studied In Situ on Copper, Journal of the Electrochemical Society 165 (2018) C835-C841.