# Effect of various electrolytes on zinc corrosion investigated by scanning flow cell system with dynamic electrolyte change

Claudius A. Laska, Karl J. J. Mayrhofer,
Myriam Madani*, Joost De Strycker*

Max-Planck Institut für Eisenforschung GmbH,
Düsseldorf, Germany
* ArcelorMittal Global R&D Gent, Zelzate, Belgium
c.laska@mpie.de

Zinc based coatings are of tremendous importance for corrosion protection and are object of research since decades. Multiple techniques were utilized to study, simulate and predict the performance of zinc based protective coatings under environmental exposure conditions. Still, the variety of parameters require continuous reviewing of the employed methods with regard to significance and reliability.

Under wet conditions electrolyte composition constitutes the most important parameter determining the corrosion behavior. Chloride and sulfate for example represent aggressive ions, while carbonate and phosphate show considerable inhibitive effects. Even though their influence has been individually well studied, the competitive role of inhibitive and aggressive ions in electrolyte systems with varying concentrations over time has not been investigated due to the high experimental demands.

We present here an innovative micro electrochemical scanning flow cell system with downstream online analysis of the product stream [1] able to deal with the issue of the complex interrelation between the variable electrolyte composition and the corrosion behavior. The fully automated system provides dynamic electrolyte exchange even during the measurement and thereby allows a comprehensive investigation of the individual effect of different electrolyte constituents with temporally varying concentrations. Facing this challenge it proves highly beneficial to have a direct linking between electrochemical measurements and the dissolution rate to reveal a comprehensive picture of the underlying processes.
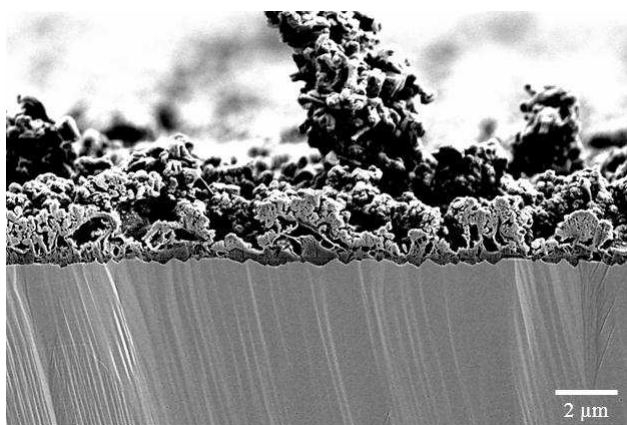


Fig. 1 Cross-section of precipitation layer formed on zinc foil in 1 mM $NaHCO_3$ + 0,1 M NaCl solution

Complementary, state of the art cross-cutting techniques are employed to have a direct observation of the morphological structure of the corrosion products and their distribution along the thickness of the sample.

Implications from these studies for the development of enhanced corrosion resistant materials according to environmental exposure conditions will be discussed.

## References:

[1] S. Klemm, A. Topalov, C. Laska, K. Mayrhofer, Corr. Sci., 51 (2009) 1251–1262.

[2] B. Conway and D. Kannangara, J. Electrochem. Soc., **134** (1987) 906-918.

[3] P. Volovitch, C. Allely, K. Ogle, Corr. Sci., **51** (2009) 1251–1262.